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ABSTRACT

Schools have been faced with design and technology changes over the past few years, raising issues when planners consider both new and existing school accommodations. This document illustrates typical design examples and suggests an approach which individual schools can use to assess their own design and technology accommodation requirements. Section 1 gives a guide to the number, type, and size of teaching spaces that are likely to be required, and describes the range of non-teaching support spaces, outlining key points to consider when planning the overall suite of spaces. Section 2 goes into more detail about the size and planning of individual spaces and includes furnished layouts of typical specialist rooms. Section 3 provides detailed information on both teaching and non-teaching support spaces. Section 4 offers advice on the most typical furniture used in design and technology spaces. Section 5 describes typical workshop equipment and guidance on their accommodation needs. Section 6 outlines key points about servicing design and technology spaces and provides references to more detailed information. Section 7 includes case studies involving design exercises and actual building projects illustrating new and adapted accommodation for design and technology. Section 8 includes general cost advice on buildings, furniture, and equipment and gives general cost breakdown of two school adaptations. Appendices include guidance on the distances normally allowed around workbenches and machines, the main points of the Health and Safety law, a check list, and a glossary. (Contains 40 references.) (GR)

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ED 431 297

DESIGN AND TECHNOLOGY ACCOMMODATION IN SECONDARY SCHOOLS

A Design Guide

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Design and Technology Accommodation in Secondary Schools

A Design Guide

Architects and Building
Department for Education and Employment

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Introduction

This publication provides guidance on accommodation for design and technology in secondary schools. It is intended to assist all those who may be involved in the briefing and design process including teachers, governors, LEA advisers and building professionals. It discusses the issues that arise when considering both new and existing accommodation.

Design and technology has been through a period of change over the last few years. It is part of the National Curriculum and is taught to all secondary age pupils from 11 to 16[1]. Schools vary in the way in which they choose to deliver the subject and this will influence their accommodation needs. The guidance given in this publication is not prescriptive. It illustrates typical examples and suggests a flexible approach which can be used as a guide against which individual schools can assess their own requirements. Local authorities and schools will, of course, establish their own building priorities in the light of the funds they have available for capital work and any conditions which may attach to these funds.

As with other subjects, the accommodation needs of design and technology should be considered in the context of the whole curriculum. It is recommended that both specialist advisers and building professionals, as well as the school, are involved with the analysis and planning.

The publication does not include any detailed information on the accommodation needs of A-level or vocational courses and there is no specific advice for special schools. However, the general guidance will be applicable to all secondary schools and the case studies illustrate a range of school types including a middle school.

What the Publication Contains

Section 1 provides a broad overview of design and technology accommodation. Sections 2 to 8 contain more detailed information. A brief description of each section is given here.

Section 1: Planning for Design and Technology gives a guide to the number, type and size of teaching spaces that are likely to be required. It also describes the range of non teaching support spaces and outlines some of the key points to consider when planning the overall suite of spaces.

Section 2: Timetabled Teaching Spaces goes into more detail about the size and planning of individual spaces and includes furnished layouts of typical specialist rooms.

Section 3: Support Spaces provides detailed information on both teaching and non teaching support spaces.

Section 4: Furniture and Finishes gives detailed advice on the most typical furniture used in design and technology spaces.

Section 5: Equipment describes typical workshop equipment and provides guidance on their accommodation needs.

Section 6: Services and Environmental Design outlines key points about servicing design and technology spaces and provides references to more detailed information.

Section 7: Case Studies includes design exercises and actual building projects illustrating new and adapted accommodation for design and technology.

Section 8: Cost Guidance includes general cost advice on buildings, furniture and equipment and gives a cost breakdown of two school adaptations.

The appendices include guidance on the distances normally allowed around workbenches and machines, the main points of Health and Safety law and a check list. The Bibliography lists a number of documents relevant to the provision of design and technology accommodation in secondary schools.

Notes
[1]From 11 to 14 in Wales.

Section 1: Planning for Design and Technology

This section gives an outline of the range of spaces appropriate to design and technology. It includes planning principles that can be used as a guide when designing new or adapting existing accommodation.

1.1 Design and technology is essentially a practical subject involving pupils in both designing and making. Products will be made in a wide range of materials including wood, metal, plastics and textiles (often in combination) and food. When designing, pupils will read, write, sketch and make models. They will test and evaluate their own ideas as they are developed and they will learn a number of graphic skills (including some that are computer based) for presentation purposes and for construction detailing. When making, pupils will shape, form and mould materials using a variety of hand tools and machines. Processes will range from hand weaving to aluminium casting.

1.2 Pupils will learn about and make use of a variety of control systems including mechanical, electrical, electronic and pneumatic. They will learn how to program a computer which will control manufacturing equipment as well as learning how to operate machines manually. In addition to acquiring skills and knowledge about processes and materials they will learn about the cost and time involved in manufacture. Pupils may spend a significant amount of time working individually or in small groups on a project.

The Range of Spaces

1.3 The spaces required to teach design and technology (D&T) will vary from school to school but will include timetabled teaching spaces and support spaces for teaching and non teaching purposes.

Calculating The Number of Timetabled Spaces

1.4 The number and type of timetabled spaces will depend on the size of the school and the way in which the subject is organised. In order to assess the overall number of specialist spaces needed, the proportion of pupils' time to be spent in design and technology and the availability of teachers will need to be identified, both for the present and, as far as possible, for the future. The group sizes determined from this analysis will affect the number of spaces: the smaller the group size, the greater the number of groups and therefore rooms. Account should be taken of any A-level or GNVQ courses likely to be offered. A large number of post-16 pupils following design and technology related courses may justify a defined specialist space.

1.5 Table 1/1 shows the number of spaces generated by three curriculum models for different school sizes. The models reflect a breadth of school type within the 11 to 16 age range. Model 1 has the smallest percentage of curriculum time devoted to D&T and may apply to a school where only half the KS4 pupils take the full GCSE course. Models 2 and 3 show higher percentages of curriculum time. Model 3 may reflect a school which has a curricular emphasis on science and technology.

1.6 Table 1/1 also shows the average frequency of use for each space (the amount of time it is used compared to the total time it is available). Where rounding up to the nearest whole number results in a frequency of use above 85% the next highest number of rooms is shown. Where the frequency of use lies between 85% and 90%, two figures are given. The smaller number of rooms which results in a more efficient use of space is preferable. However, since each of these spaces has a specialist function it may be difficult to organise the school timetable to achieve a frequency of use above 85%. If the figure falls below 60% it is advisable to consider equipping a space for more than one specialist function, this is particularly applicable to smaller schools. The extent to which this can take place will be limited by considerations of safety and hygiene. Food technology, for example, cannot be combined easily with other specialisms.

			4FE	5FE	6FE	7FE	8FE	9FE
		No. on Roll	**600**	**750**	**900**	**1050**	**1200**	**1350**
Model 1	A	D&T teaching periods	102	119	141	162	192	213
7.5% pupil time on D&T (KS3&KS4 average)	B	Weekly timetable periods	40	40	40	40	40	40
40 period week	C	Calculated no. of spaces (A/B)	2.6	3.0	3.5	4.1	4.8	5.3
	D	**Rounded no. of spaces**	**3**	**4**	**5(4)**	**5(4)**	**6**	**6**
	E	Frequency of use (C/D)	85%	74%	70%(88%)	69%(86%)	80%	76%(89%)
	F	D&T pupil periods	1560	1950	2340	2730	3120	3510
	G	Average group size (F/A)	15.3	16.4	16.6	16.9	16.3	16.5
		No. on Roll	**600**	**750**	**900**	**1050**	**1200**	**1350**
Model 2	A	D&T teaching periods	128	156	180	216	248	260
10% pupil time on D&T (KS3&KS4 average)	B	Weekly timetable periods	40	40	40	40	40	40
40 period week	C	Calculated no. of spaces (A/B)	3.2	3.9	4.7	5.4	6.2	6.5
	D	**Rounded no. of spaces**	**4**	**5**	**6**	**7(6)**	**6(7)**	**8**
	E	Frequency of use (C/D)	80%	78%	78%	77%(90%)	78%(89%)	81%
	F	D&T pupil periods	2400	3000	3600	4200	4800	5400
	G	Average group size (F/A)	18.8	19.2	19.1	19.4	19.4	20.8
		No. on Roll	**600**	**750**	**900**	**1050**	**1200**	**1350**
Model 3	A	D&T teaching periods	144	172	220	240	288	316
11.2% pupil time on D&T (KS3&KS4 average)	B	Weekly timetable periods	40	40	40	40	40	40
40 period week	C	Calculated no. of spaces (A/B)	3.6	4.3	5.5	6.0	7.2	7.9
	D	**Rounded no. of spaces**	**5(4)**	**6(5)**	**7(6)**	**8(7)**	**9(8)**	**10(9)**
	E	Frequency of use (C/D)	72%(90%)	72%(86%)	79%	75%(86%)	80%(90%)	79%(88%)
	F	D&T pupil periods	2688	3360	4032	4704	5376	6048
	G	Average group size (F/A)	18.7	19.5	18.3	19.6	19.7	19.1

Table 1/1
Numbers of Spaces for a Range of Models

Note: These models represent typical 11-16 schools. Vocational courses are not included.

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The Balance of Timetabled Spaces

1.7 Whilst design and technology is a single subject it encompasses a range of different activities requiring a variety of specialist facilities. The range can be divided broadly into the following categories:

- multi-material construction: working with wood, metal and plastics;
- control technology: for smaller scale work with, for example, electronic and pneumatic control systems;
- food technology: designing and making with food;
- textiles: designing and making with textiles.

These activities may be overlapped or combined in different ways. Some schools prefer to provide fully multi-purpose spaces (excluding food), an example of which is illustrated in Section 7 (Case Study 6). However, as this involves a wide range of facilities in every space, it is generally more economic to provide a series of spaces each furnished, equipped and serviced for a limited range of specialist activities as well as a common core of general activities. Section 2 describes in detail the activities that take place and illustrates possible furniture layouts for timetabled specialist spaces.

1.8 The balance of specialist spaces will vary depending on a schools' size and its particular curricular emphasis. Table 1/2 shows some of the likely combinations of specialist spaces for three sizes of department. These examples are not intended to cover every possibility but they introduce some interesting issues. The case studies in Section 7 illustrate some of these situations.

- In a small department there is often some overlapping of facilities such as multi-materials with control technology (model C) or textiles with control technology (model B).
- If the only solution is to teach food and textiles in the same space, for example in a small department (model C), it is essential that the layout of the room and the way in which the activities are managed take into account the need for a safe and hygienic environment for food preparation.
- If there is only one multi-materials workshop (models A and B), it will have to house a broader range of equipment and may need to be larger than average.
- In a large department it is possible to provide a greater variety of specialist spaces. Models G and H, for example, have a space equipped specifically for graphics.
- Where there are three or four multi-materials spaces, each one can be furnished and equipped to provide for a different emphasis. For example, one space may have a bias towards computer controlled manufacture.

Table 1/2
Balance of Specialist Spaces

	Small Department			Medium Department			Large Department		
SPECIALIST SPACE	A	B	C	D	E	F	G	H	I
Multi-materials	1	1		2	3	2	3	2	2
Multi-materials/ control (electronics/ pneumatics etc)			2						
Small scale multi-materials/ control/ graphics	1			1		1	2	2	2
Control				1	1		1	1	
Textiles	1			1		1	1	1	2
Control/ textiles		1							
Food		1			1	1		1	2
Food/ textiles			1						
Graphics							1	1	
Total number of spaces	3	3	3	5	5	5	8	8	8

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The Size of Timetabled Teaching Spaces

1.9 The size of a teaching space will depend on the range of activities taking place, the maximum group size likely to be accommodated and the amount of storage to be kept within the classroom.

1.10 Section 2 shows teaching spaces that are large enough for up to 21 pupils[1] (assuming some local storage in the room but with most storage kept separately in 'walk - in' store rooms). These examples show clearly the relationship between the size of a teaching space and the type of specialist activity it accommodates. The scale of equipment and machinery is a major influence. The following are illustrated:

- spaces of 80-85m² for groups of up to 21 pupils doing small scale practical activities such as textiles or graphics.
- Spaces of 100-105m² for groups of up to 21 pupils involved in larger scale activities such as making with wood, metal and plastics or working with food.

The size of these spaces is adequate for a typical range of specialist activities together with associated general activities such as writing, drawing and teacher presentation. However, the range and combination of specialist activities varies between schools. The relationship between activity and area is described in more detail in Section 2 and examples of spaces of different sizes are shown in the case studies in Section 7.

1.11 In a new building which is designed for pupils up to the age of 16, limiting the range of different room sizes can increase the potential interchangeability of spaces and result in long term flexibility.

Teaching Support Spaces

1.12 The timetabled teaching spaces will be supplemented by a range of untimetabled teaching areas. These may include:

- **a design/resource area.** This can provide a number of facilities which are useful to different specialist activities and which would be costly to provide in every room; for example computers with CD ROM, additional drawing tables and books. It may be the place to display products and pupils work.
- **A project room.** This may be provided in a school with a sixth form, for example, allowing pupils to work in their own time on an aspect of a project that can be carried out without supervision.
- **A seminar room.** A small quiet room can have a number of uses including holding 'mini-enter¡rise' meetings. It is likely to be shared with other departments and may be combined with a staff base.
- **An external project area.** A covered external area can be used for building large scale structures and testing products where more space is needed. It may also be a place where particularly messy or dirty activities take place.

1.13 The sizes of these spaces will depend on the particular needs and priorities of the school and some spaces may be combined. The design/resource area is described in more detail in Section 3.

Non-Teaching Support Spaces

1.14 All of the teaching spaces require additional area for storage. Table 1/3 gives a guide to the storage area that may be required for each specialism. These figures are supplementary to the suggested teaching areas in paragraph 1.10, which include an allowance for some local storage. The areas are given per pupil place because the numbers of pupils being taught affects the quantity of materials used and thus the storage area required. A constant frequency of use of the room is assumed. A range of area is shown since circumstances will vary. Factors that can affect storage area requirements include:

- Size of department: there is a basic level of equipment/materials irrespective of a department's size. Therefore, in a small department this core may be concentrated into fewer spaces and there may be some economies in a large department.

Note
[1] reflecting the typical maximum group size in secondary schools

- Range of activities: a multi purpose space may need access to a greater variety of materials.
- Size of pupils' products and the extent to which work is kept in the school.

Table 1/3
Suggested storage areas per pupil place

Note
PP (pupil place) = a place to work for one pupil

SPECIALISM	AREA PER PP (m^2)
Multi-materials	0.6 - 0.8
Electronics/ control	0.5 - 0.6
Textiles	0.4 - 0.5
Graphics	0.3 - 0.4
Food	0.5 - 0.6

1.15 There should also be somewhere for the preparation of resistant materials, preferably in a room that is separated but accessible from the main teaching areas. A space of around 30-35m^2 will accommodate a work area with a typical range of machinery and will be the same whatever the department's size. This is additional to the areas shown in Table 1/3 although materials' storage is often combined with a preparation area.

1.16 A design and technology department may include a staff base where staff from different specialisms can prepare work and hold meetings. This base can also provide secure storage for items such as pupils' records.

1.17 Detailed requirements for these support spaces are described in Section 3.

Planning Principles

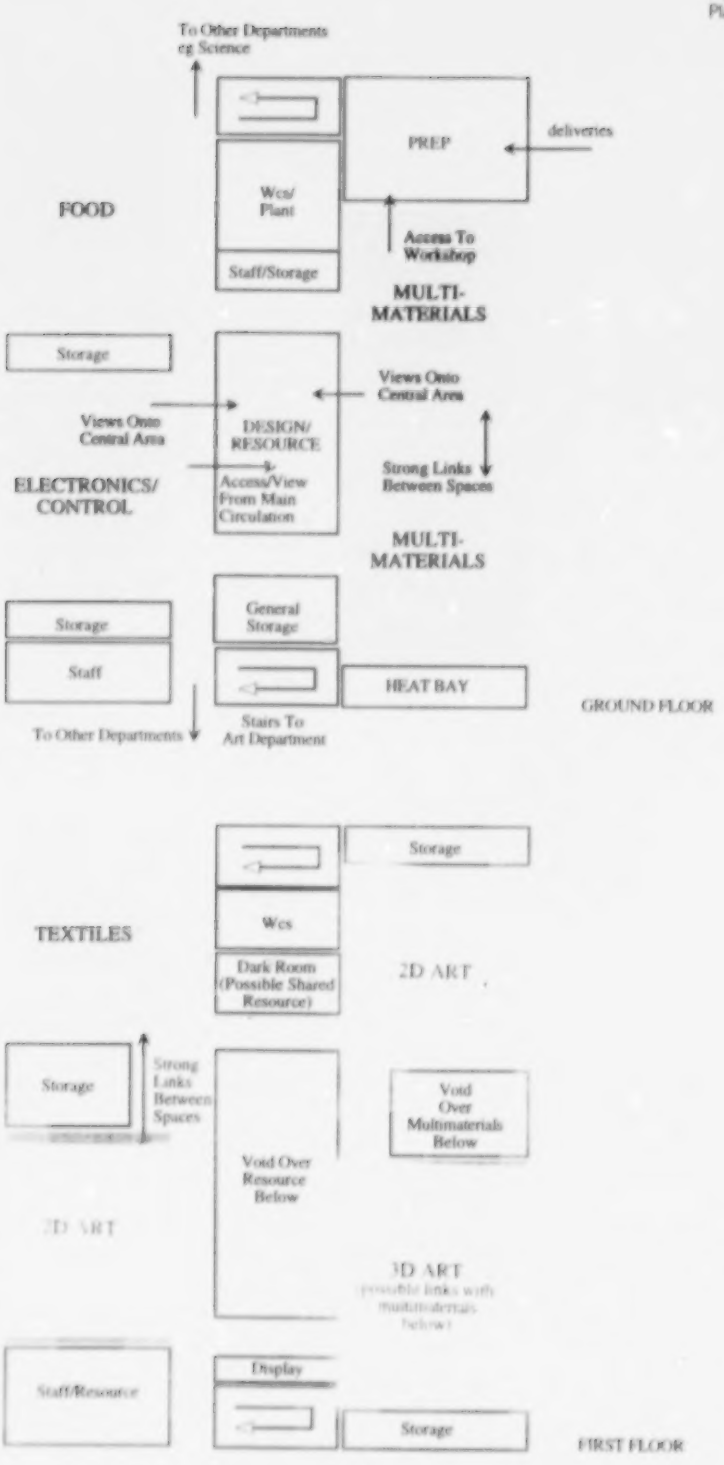
1.18 When pupils are developing their projects they may wish to use a range of materials or processes. For example, a pupil may want to make a product which combines wood and textiles. Teachers often arrange design and technology projects to encourage links between specialist areas. If spaces are grouped together it allows pupils to make maximum use of a range of facilities. The principle of 'grouping' can be applied to as few as two spaces, for example a multi-materials space and an electronics/ control space, or it may be relevant to a whole suite of spaces. The latter is most easily achieved in new building work.

1.19 Locating spaces together has the advantage that a number of rooms can have access to shared facilities such as a design/ resource area. Many design and technology activities take place in well serviced spaces and the grouping of these together can make servicing provision more economical.

1.20 The diagrammatic plan in Figure 1/1 shows a two storey design and technology block with art on the first floor. This is one example of a medium sized department and there will be many different solutions. However, this illustrates some of the key points to consider when planning design and technology accommodation. These points are worth considering for either new or existing accommodation.

- Departmental identity can be strengthened by locating all spaces that contribute to design and technology in the same suite.
- There are certain spaces between which pupils are more likely to move in order to make full use of available equipment. Therefore spaces such as the two multi materials workshops should ideally be located closely together.
- The position of the materials preparation room should allow for the convenient delivery of materials and technicians' access to workshops.
- A centrally located shared resource area, alongside the main circulation route, is accessible to all pupils including those from other departments.
- Glazing in partitions (above worktop height) provides a visual link which can create a sense of departmental integration and help teachers to supervise shared areas.
- Opportunities for sharing equipment and materials are maximised if other departments with related activities such as science, are within easy reach.

Figure 1/1
Planning Principles



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Section 2: Timetabled Teaching Spaces

Design and technology will be taught in a number of specialist spaces, with variations between schools as described in Section 1. This section shows furnished plans of typical specialist spaces and describes the activities that are accommodated. Guidance is also given on the size of spaces where facilities vary from those illustrated. The section starts with general planning points which are relevant to all spaces.

Preparing a Room Layout

2.1 Furniture and equipment layouts can be used to test the suitability of a building design proposal and to prepare budget costs. It is worthwhile preparing them for every teaching space early on in the design process.

Figure 2/1
General activities in Design and Technology:
a: Whole group evaluation
b: Sketching

2.2 Each space will need to be furnished and equipped to allow for a range of specialist activities (see Figs. 2/2). There are, however, some general activities which are common to all areas (see Figs. 2/1). All pupils will need to be able to read, write, and sketch as well as take part in whole class discussions, presentations and project evaluations. Whole class briefing may take place at the start of a project or in order to explain a new skill. Pupils may also gather around the teacher for short briefing sessions, often standing.

2.3 The furniture and equipment layout of each space should be flexible enough to accommodate the appropriate specialist activities alongside the general activities. The layout must also enable pupils at different stages of a project to be involved with different activities.

2.4 The shape of a space will affect the layout. A regular shape without indentations is generally easier to organise and more adaptable in the longer term. A narrow room can be difficult to plan, particularly where large items of equipment and furniture are involved. A proportion of between 1:1 and 1:1.3 will generally allow for a variety of furniture and equipment arrangements.

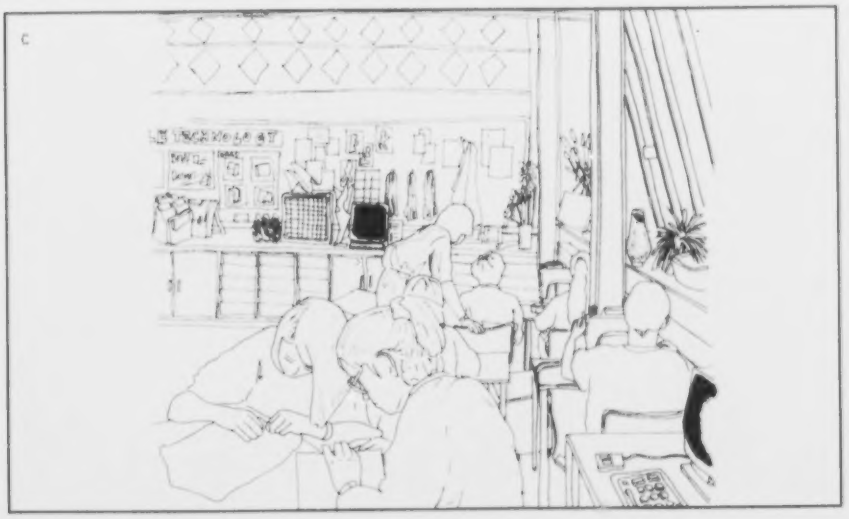


Figure 2/2
Specialist activities in Design and Technology:
a: Making in Food
b: Making in Multi-materials
c: Making in Textiles

Note
[1] A working position: a worksurface of at least 0.36m²

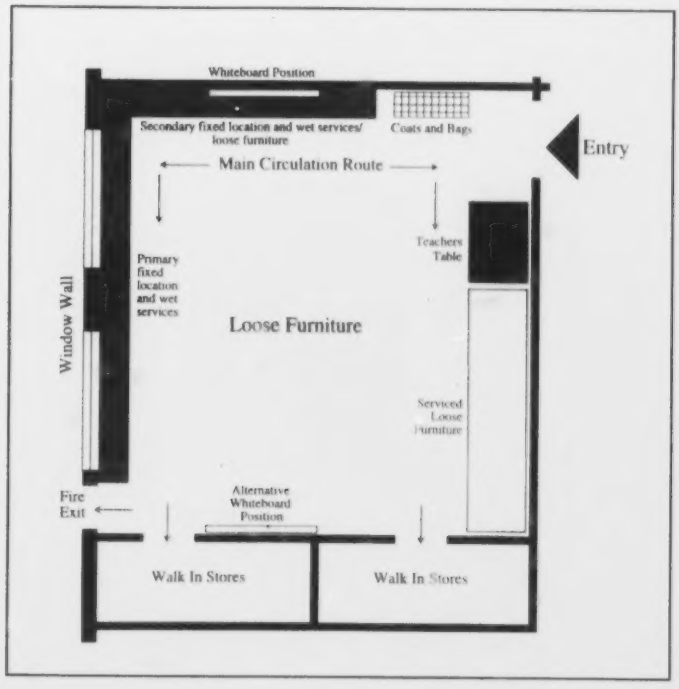
A Planning Strategy

2.5 All the spaces illustrated in this section are planned on the basis of the following strategy, which is intended to provide a space which has the flexibility to accommodate a broad range of activities in safety and comfort (see Figure 2/3):

- Each space provides a work surface position for up to 21 pupil places[1].
- Heavy duty machinery is located mainly on external walls.
- Services are located on both external and internal walls.
- Fixed work surfaces are kept to a minimum and are located around the perimeter.
- The centre of the space is free of fixed furniture and serviced equipment. The loose furniture can be arranged in order to accommodate a variety of activities. Additional servicing in the centre of the room can be obtained through the use of serviced loose furniture.
- The teacher position provides good views of the entrance and of the space as a whole.
- Computers and whiteboards are positioned at 90° to the window wall to avoid reflection and glare. (Where this is not possible blinds could be provided.)
- Full height storage is avoided. Most local storage is mobile and can be positioned under benching, making most effective use of the space (see Section 4).
- Store rooms are accessed from one end of the space (see Section 3).
- A storage facility for pupils coats and bags is included, adjacent to the room entrance (see Section 4).
- Distances around tables, benches and machines are sufficient to allow for safe circulation and use of furniture and equipment (See Appendix 1).

2.6 Once a framework is established it is helpful to consider the particular activities taking place in order to refine the layout. Relevant furniture and equipment can then be worked into the plan as the brief is developed.

Figure 2/3
Planning strategy diagram



Planning for Different Activities

2.7 Each of the specialist activities are described below, illustrated by typical examples of furnished plans. Although only one solution is shown in each category, some of the variety of type and size is described and further examples are shown in the case studies in Section 7. Details of the furniture and equipment shown on the plans can be found in Sections 4 and 5.

2.8 A larger space than those described may be appropriate if the school has a sixth form in which a large amount of design and technology is taught or if vocational courses are offered in subjects such as manufacturing, engineering or catering. Such courses may demand additional specialist equipment and schools may find it necessary for individual sixth form pupils to be able to work in a space at the same time as a group of younger pupils.

Multi-materials (Fig. 2/4)

2.9 Multi-materials workshops provide pupils with the opportunity to work with a variety of construction materials such as wood, metal and plastics using a range of techniques. When planning these spaces, it is important to take into account the function of each machine to ensure that adequate space is allowed for it to be fully operated in safety. Reference should be made to Section 5 and Appendix 1.

2.10 This example shows two rooms divided by a half-glazed partition, with double doors connecting the two. Multi-materials 1 contains pedestal machinery for both wood and plastics whilst Multi-materials 2 contains the majority of the engineering equipment.

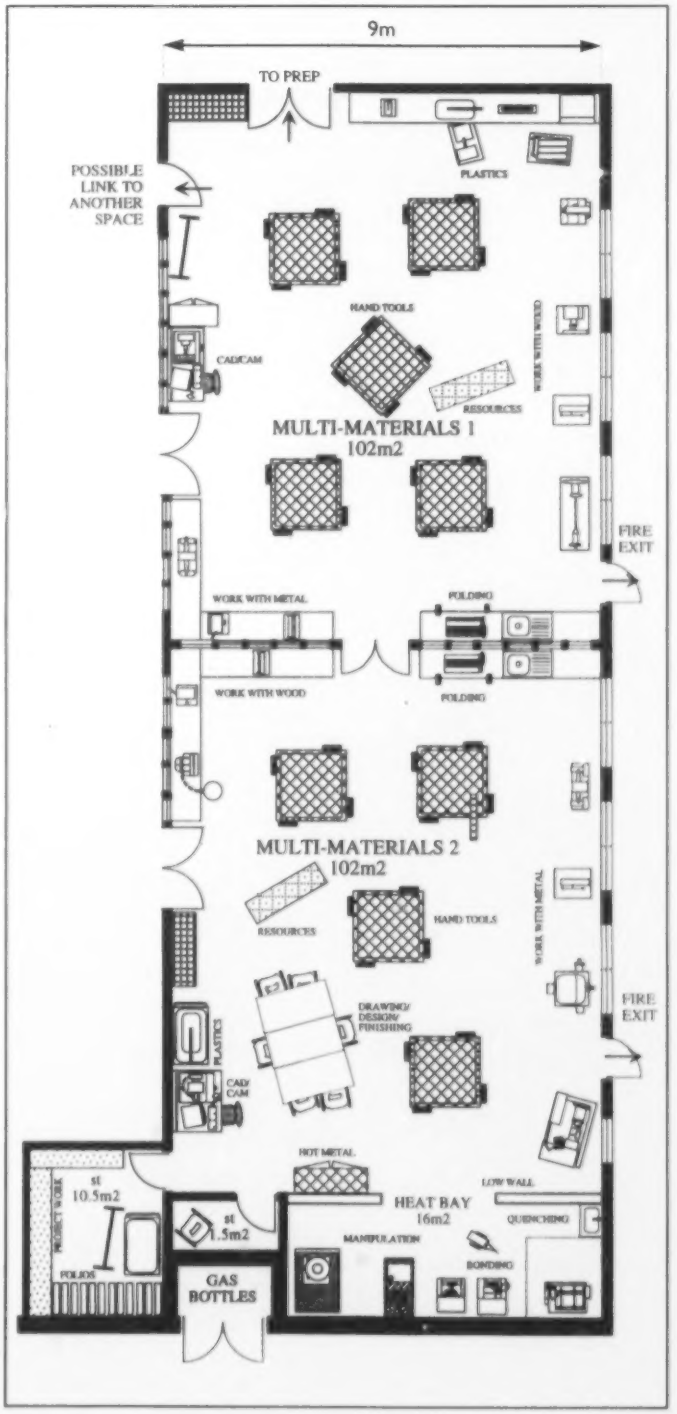
2.11 All pedestal mounted machinery is placed along the external wall with good natural lighting. This arrangement also provides a convenient sight line for supervision. Perimeter work surfaces house complementary machines to enable each workshop to be multi-purpose, i.e. in Multi-materials 1, the pedestal machines are used primarily for wood and bench-mounted machines are used with metal (the opposite is shown in Multi-materials 2). This avoids the duplication of large pedestal machinery. Computer controlled machines provide pupils with an opportunity to gain experience of computer aided design and manufacture and ensure that the workshops are fully multi-purpose.

2.12 Activities such as brazing and casting take place in the heat treatment area adjoining Multi-materials 2. This area is separated from the main workshop by a low wall which allows for good supervision by staff. It also allows pupils to gather safely in the workshop area to watch the teacher demonstrate heat treatment techniques. An 850mm high metal cupboard provides a work surface to leave recently forged or bonded metal until it is cool. It may also house the specialist resources required for the heat treatment area. A sink with hot and cold water and a quenching sink is provided[1].

2.13 Multi-benches, with open under frames and vices for work in wood or metal, offer the opportunity of using a variety of hand tools. Pupils may also sit at these multi-benches if necessary for more formal parts of a lesson, for example drawing exercises. In Multi-materials

Note
[1] BS 4163 Workshops in schools and other similar establishments 1984 BSI

Figure 2/4
Multi materials workshops



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Note
[2] BS 4163 Workshops in schools and other similar establishments 1984 BSI

2 the fifth workbench is replaced by three basic tables (see Section 4) which can provide a clean surface for design work. Two additional vices are positioned on the side bench to give eighteen hand tool positions. Drawing boards and stools for use at tables or multi-benches can be kept in the adjacent storeroom when not in use[2]. The drawing and design facilities may be complemented by those provided in a central resource area (see Section 3). Mobile storage units can be wheeled under the perimeter benching or the multi-benches. A trolley housing various resources from the preparation area (e.g. hand tools, material off-cuts etc.) is shown in each workshop (see Section 3).

2.14 The spaces illustrated here, at 102m² (excluding heat treatment), allow for a typical range of designing and making activities using pedestal and bench mounted machines as well as some computer and table work. A space with a reduced range of making activities and no design tables may be 85m²-95m². Such a space may be suitable where there is another larger multi-materials space nearby or where design work can take place in an adjacent design area. If sufficient electronics tables for 21 were shown alongside the range of facilities shown here (for example in a small school where multi-materials and electronics must take place in one space) then a space of 120m²-125m² may be more appropriate.

Electronics/Control (Fig. 2/5)

2.15 The electronics/control room shown here provides for a range of activities including the design, construction and assembly of mechanical, electrical, electronic and pneumatic components and systems. The serviced perimeter work surface is complemented by independently serviced tables which may have outlets for power (including low voltage) and compressed air. These tables enable pupils to carry out experiments with electronic construction kits as well as providing surfaces for design activities. The four unserviced tables can be used for general design activities or positioned at the end of the serviced benches to create more work surface. Computer controlled equipment, bench mounted machinery, a multi-bench and a resources trolley provide facilities for the 'design and make' activities which may take place as part of control technology, for example constructing three dimensional models or housings for electronics. There is sufficient flat table surface for all pupils to undertake drawing activities at one time. Loose drawing boards, normally kept in the storeroom, enable this room to be used for graphics lessons.

2.16 The 87m² space shown here allows for a range of activities including a small amount of construction. If the construction facilities were omitted, the area could be reduced to 75-80m². This is acceptable where pupils can make use of nearby workshops but it is not ideal as it

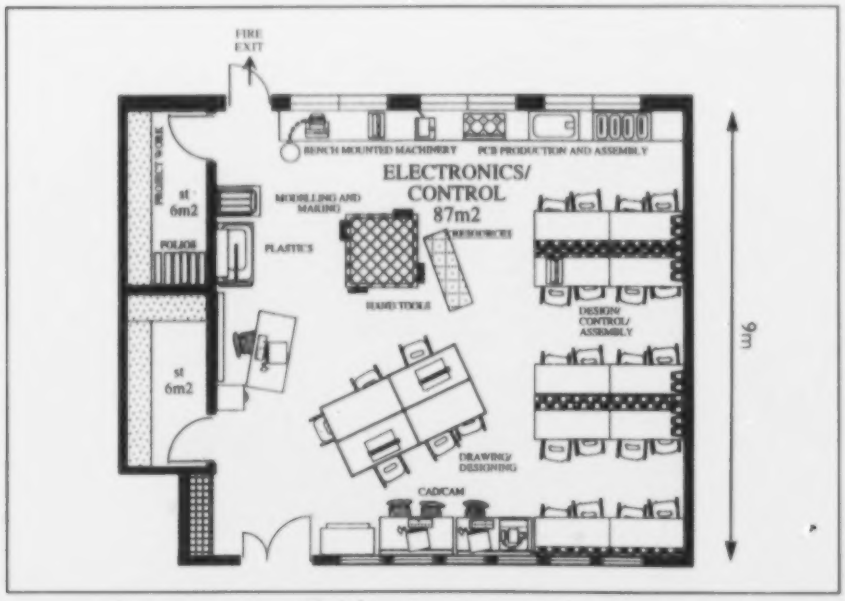

Figure 2/5
Electronics/ Control

imposes limitations on curriculum organisation and may require careful supervision. It also limits the kinds of activities which may take place. In some schools electronic activities may take place in each multi-materials workshop which can increase the flexible usage of the space, especially at KS3 where a wide variety of activities may be required to take place in one area (see Multi-materials and Section 7: Case studies 2, 5 and 6).

Textiles (Fig. 2/6)

2.17 The textiles room shown here is generally a 'clean' area used for a variety of fabric-based design and construction activities. Pupils may use sewing and knitting machines, work with fabrics by hand and test and analyse fabrics. The work surface along the external wall provides facilities for textile technology (such as an abrasion tester) as well as a laundry area. The adjacent lower work surface houses sewing machines and an overlocker. It is shown here as a fixed bench but could be made up of a series of loose tables. Cupboards under the worksurface enable machines to be stored when not in use.

2.18 Computerised machines alongside an IT bay are provided giving pupils the opportunity to design and make products with CAD/CAM equipment. The central area, furnished with loose basic tables, is used for design, fabric cutting and lighter activities such as weaving. Some fabric printing activities may take place in this room, using small screen printing frames which may be temporarily secured to a standard table. Space inhibits the use of a full size screen printing table, although a loose top positioned over a series of tables could be used and stored in the storeroom when not in use (see Section 4). Some resources for printing may be shared with the art department.

2.19 A space of 80-85m², as shown here, provides a satisfactory range of 'clean' textiles activities. A space of around 70m² could accommodate up to 21 pupils carrying out a more limited range of making and testing activities. An example is shown in Section 7 (Case Study 5). A larger space than the one shown may be appropriate where textiles is taught in an integrated way with 'wet' textiles (i.e. screen printing and other art based activities). Such a space could be between 85m² and 95m².

Graphics (Fig. 2/7)

2.20 Graphics may be taught in one of the specialist spaces using portable drawing boards (electronics is often used as it is provided with a good provision of flat top tables). However, in some situations a dedicated graphics room may be preferred. The graphics area shown here provides work

Figure 2/6
Textiles

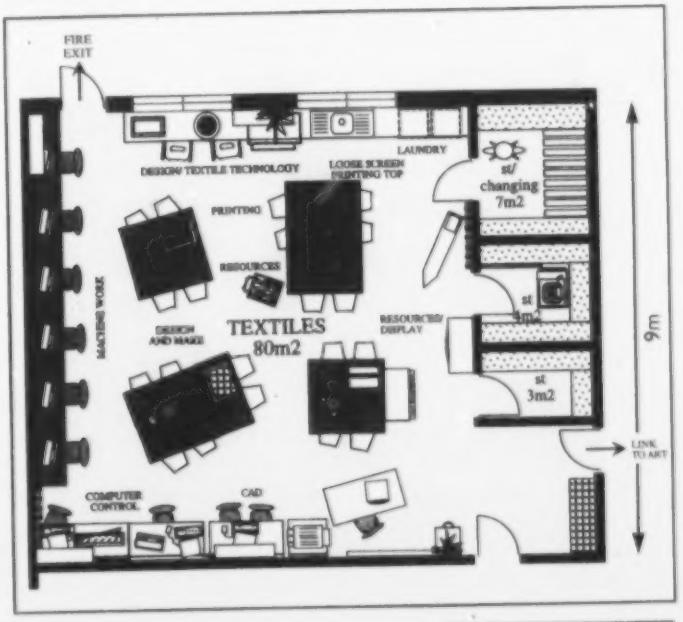

Figure 2/7
Graphics

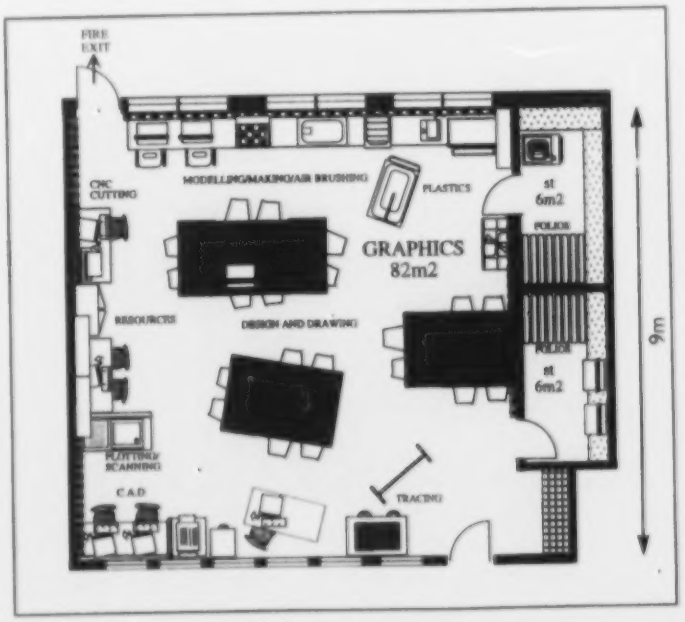

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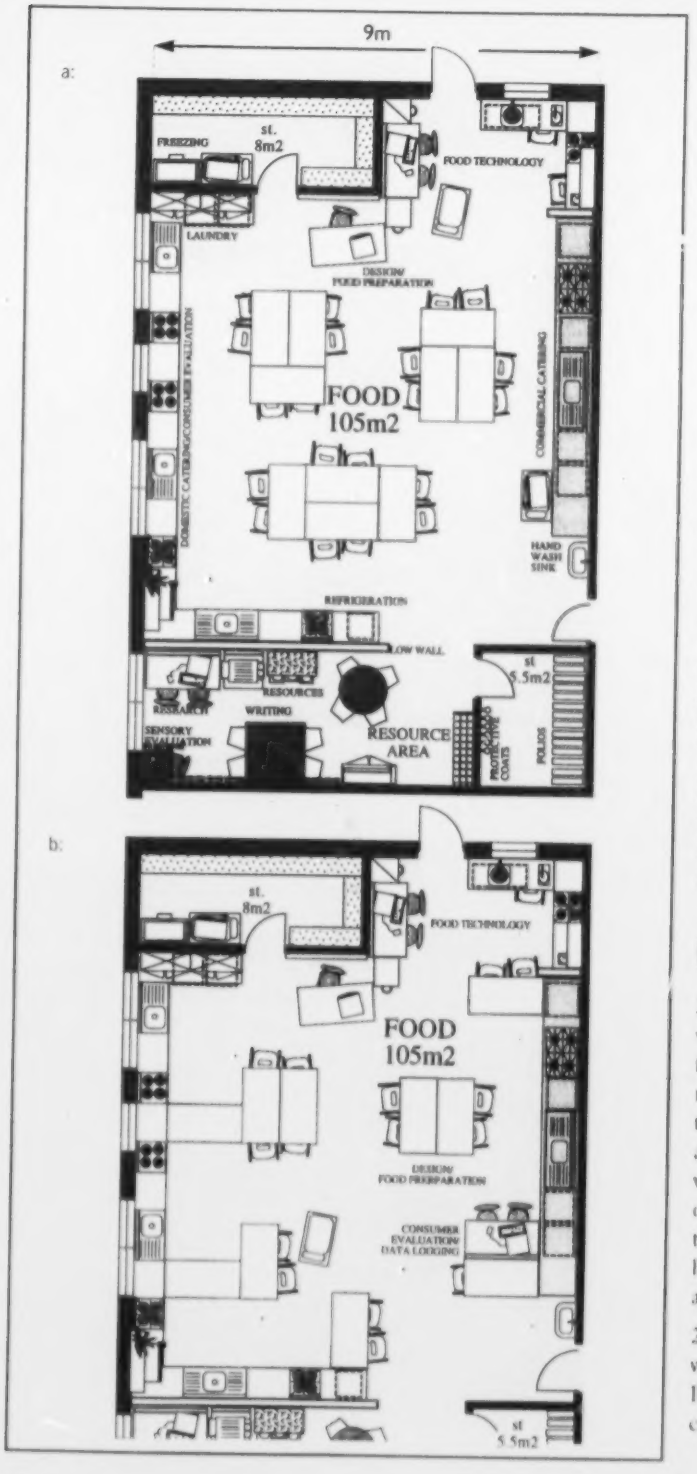
Figure 2/8
Food room:
a: Standard room layout
b: With furniture re-arranged



surface and loose drawing boards for 21 pupils as well as IT facilities particularly for use with CAD packages. This layout incorporates a limited amount of computerised and manual equipment for making (mainly in plastic materials). A vinyl cutter which would work in conjunction with a computer is also shown. This may be used for projects such as the design and production of signs.

2.21 A fixed bench houses trunking containing compressed air for airbrush work. This facility is shown next to the window for ventilation purposes (see Section 6). A spray booth is also shown to enable pupils to spray paint or glue small pieces of two or three dimensional work. A plan chest with a light box is provided to enable pupils to trace images. Clear space must be allowed around the chest as more than one pupil at a time may wish to use it.

2.22 The 82m² space illustrated here provides a broad range of graphics facilities. A space with less CAD equipment or no provision for making could be reduced to between 65m² and 70m². The graphics room can have a dual function if the frequency of use for the room is low. For example, a space similar to the one shown here could be used as a bookable computer base with additional computers in place of the making facilities.

Food (Fig. 2/8)

2.23 This area accommodates the various activities required for work with food including food preparation in commercial and domestic environments, food testing and consumer evaluation. It is assumed that food prepared in this kitchen would be for pupils' consumption only. However one of the requirements of the Food Safety Act (see Appendix 2), a hand-wash basin, is shown as it encourages good practise in food hygiene.

2.24 Serviced equipment and fixed work surfaces are kept to the perimeter. Perimeter only benching leaves the central area free for loose, standing

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height tables. These tables serve as additional surfaces for preparation or design work and may be butted up to the perimeter work surface if required, see Figure 2/8b. This may be a useful arrangement if pupils are using or evaluating hand held electrical equipment and need a power supply and a large amount of work surface.

2.25 Perimeter benching is provided at a height of 900mm to suit most domestic appliances which may be positioned under the worktop, to suit the varying heights of pupils from 11 to 18 and to allow for activities which involve fine delicate work where the pupil needs to be close up to the work (such as cake decoration). This layout shows all the loose tables at a standing height of 850mm (rather than 900mm) which make allowances for the smaller pupil and for activities which require downward force such as rolling pastry. A height of 850mm also allows for activities which involve the use of tall items of equipment such as large bowls or kitchen scales. A range of loose table heights (e.g. 700, 850 and 900mm) could be provided within the room, an advantage in a food room given the various types of activities which take place (see Section 4).

2.26 It is important to consider working distances and work surface provision for the food preparation area to ensure safe and effective working (see Appendix 1).

2.27 The commercial catering area incorporates large stainless steel units (see Section 4) including an oven, which could be used by pupils as a conventional cooking facility when more than the four standard cookers provided are required at one time. Microwaves and trolley mounted combination ovens also provide additional food preparation facilities.

2.28 The food technology area has an electric hob and science sink for basic experiments, development and appraisal. If this area is suitably cleaned it can also be used as an occasional additional food preparation area. Space is allowed for a computer trolley to be parked alongside the fixed bench to enable results of tests etc. to be datalogged. A freezer and two fridges are shown, sufficient to store pupils' perishable ingredients and finished products throughout one school day[3].

2.29 The adjacent tasting/reading area allows evaluation by pupils away from the main classroom and houses resources specific to the subject. A tasting booth where pupils can 'blind-taste' food consists of a small table and screen. The use of different coloured light bulbs can be used to mask the colours of food products in sensory tests, where colour differences should not be evident. In order to gain a neutral background for food tasting (i.e. no visual or aural distractions) this facility could be positioned in a ventilated storeroom. To gain a fully controlled environment however, the separate area for tasting would have to be completely sealed and air conditioned with a sealable serving hatch from the food preparation area. As this would involve considerable capital investment, schools have to fully appraise the advantages of this facility.

2.30 Coats and bags are kept in the resource area, away from the food preparation areas. Protective coats and aprons are kept in the storeroom off the resource area and can be accessed by the pupils when required.

2.31 The 105m² space illustrated here includes a separate study area for 'tasting' and research. If this were omitted or the range of cooking/practical facilities were reduced, a space for 21 pupils could be reduced to between 85m² and 90m².

Note
[3] Food Safety Act 1990 HSE

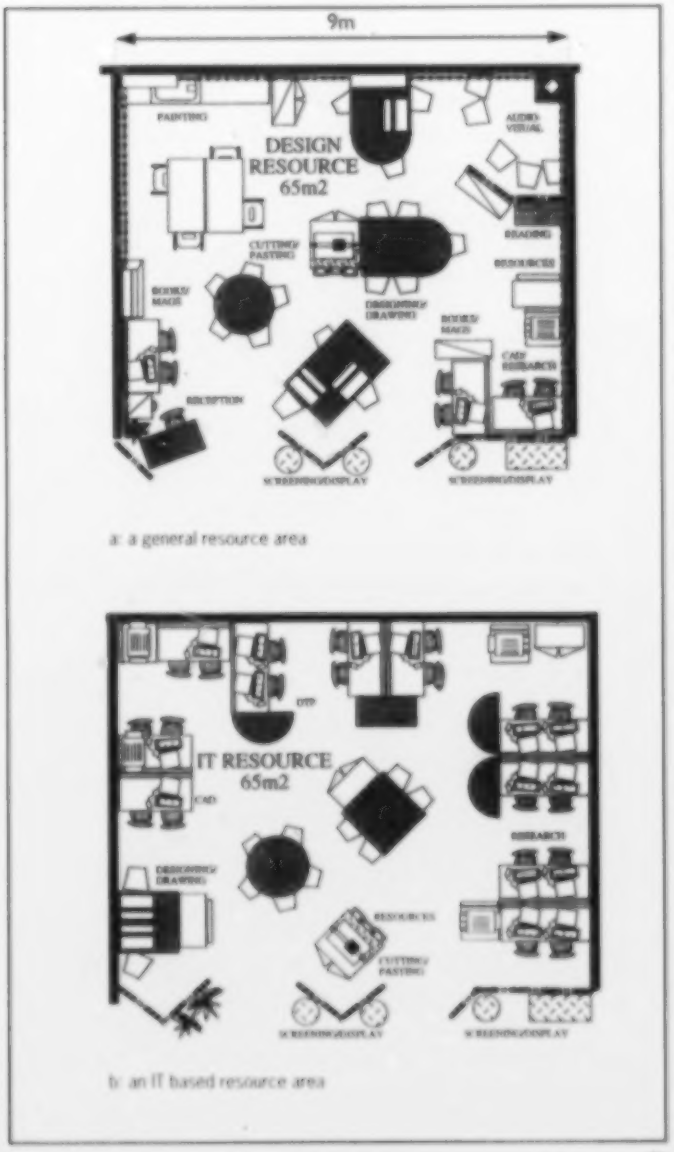
Section 3: Support Spaces

This section describes some of the untimetabled teaching and non teaching spaces which might support the main timetabled spaces in a design and technology suite.

Teaching Support

3.1 These spaces are not timetabled but they may be booked by teachers (including those from other departments) for particular activities. As these spaces will also be used informally by pupils from nearby classrooms, the possibility of indirect supervision from adjacent spaces may need to be considered.

Figure 3/1
Design Resource areas



a: a general resource area

b: an IT based resource area

A Design/Resource Area (Figure 3/1)

3.2 A good deal of pupils' work in design and technology is carried out individually and in small groups. There are a number of resources which support this work that can be accommodated centrally, allowing pupils from different specialist areas to access them without disturbing others. Such a space can also be shared with other departments. Figure 3/1 shows two possible design/resource areas which could service a group of design and technology rooms.

3.3 In Figure 3/1a, a variety of tables, together with moveable screens, create a flexible area in which pupils can draw, design and research their individual projects. An area has been included to allow small scale finishing work and painting to take place. Standing height cupboards placed next to sitting height tables create discrete work areas. A design resource area can act as a focal point to the department and display is an important feature. Screens provide vertical display surfaces whilst shelves and tables allow for horizontal display at various heights. Resources can be stored in book cases, shelves and plan chests. Lightweight materials can also be brought to the area on trolleys from adjoining specialist spaces.

3.4 Figure 3/1b shows an alternative approach where the area is primarily a computer resource which can "double" as the IT base for the department or faculty. Facilities for general design and research work are also provided by tables, storage units and display screens. In some cases such a space may be large enough to accommodate a whole class and can be timetabled for part of the time. As there are several computers in this space, the question of security would need to be addressed when choosing a location.

A Seminar Room

3.5 A seminar room can be useful as a quiet space where a group of six to eight pupils can watch a video or hold a meeting. Facilities may include a telephone, fax, or photocopier. The space may be effectively shared with another department such as business studies.

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Non-Teaching Support

3.6 Non-teaching support can include an area for the preparation of materials, a staff base and storage space.

The Materials Preparation Area (Figure 3/2)

3.7 Whilst the preparation of construction materials sometimes takes place in a defined area of a workshop, it is desirable to have a separate room. It is often convenient if this room also acts as the main materials store and delivery point. This area is normally accessible only to members of staff because it usually houses dangerous machines, including a circular saw, planer and hacksaw. All these machines require a large floor area, although mobile storage units can be housed here when preparation machines are not in use (see Section 5 and Appendix 1).

3.8 Figure 3/2 shows an example of a preparation room, serving two or three workshops. The storage systems include separate racking for wood, metal and plastic as well as cupboards for tools and small components. Particular points to note are:

- there is sufficient space for the largest timber sections and manufactured boards likely to be processed (the full size sheets assumed here are shown dotted in Figure 3/2).
- Double doors allow for the delivery of construction material and a stable door enables pupils to contact the technician without entering the prep room.
- There is an enclosed office for the technician with a window onto the main space for fire safety reasons.
- An extract unit serves the two woodworking machines and may also serve machines in adjacent teaching spaces.
- Trolleys give flexibility to the layout and facilitate the safe handling of materials. Resource trolleys, shown in their parked position, will be loaded with resources and wheeled into the adjoining workshop.
- Shelving is positioned carefully to avoid narrow gangways or obstructions that can hinder the manoeuvring of heavy loads[1].

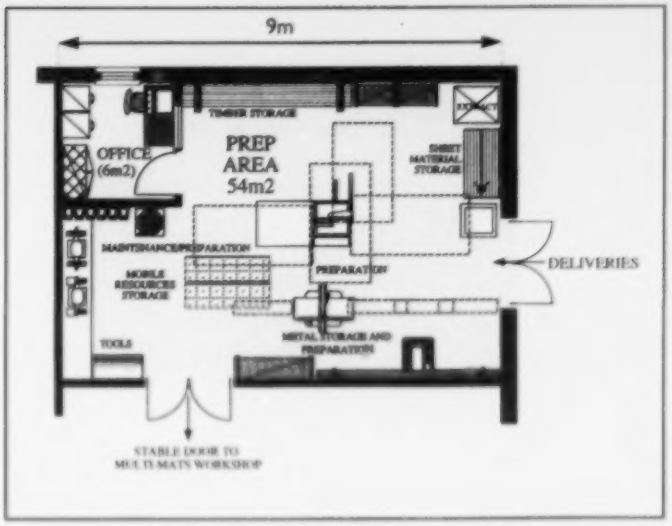

Figure 3/2
Preparation Area layout

3.9 The space of 54m2 shown here provides sufficient area for the kind of work undertaken by the technician including administrative work. It is also a storage area for raw materials. If these materials were stored elsewhere, the space could be reduced to 30-35m².

The Staff Base (Figure 3/3)

3.10 A departmental base allows staff from a number of different specialisms to meet and work together. The example shown here has sufficient work space for up to seven people, a computer and facilities for making refreshments. Lockable filing cabinets can house worksheets and pupils records. There is an adjacent secure store.

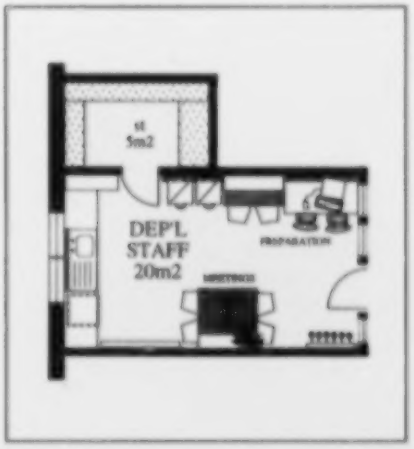

Figure 3/3
Staff Base layout

Note
[1] Manual Handling Operations Regulations 1992

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Storage Areas

3.11 Section 1 gives guidance on floor area for storage in each specialist area. Section 4 provides guidance on storage furniture. This section gives a detailed description of the range of items requiring storage and suggests how they may be stored. It is divided into four categories.

- Raw materials, tools and equipment.
- Pupils' work in progress.
- Teaching materials.
- Pupils' coats, bags and protective clothing.

Raw materials, tools and equipment

3.12 Materials for writing, drawing and computing are common to all areas. Shared equipment may include an overhead projector (OHP), TV, video recorder, computers, printers and plotters (probably all on trolleys) and mobile whiteboards. Paper in various sizes will be kept for equipment such as computer printers or a departmental fax machine. In addition each space will store a range of items to suit it's specialist activities. The list could include:

- **Food technology:** crockery, cutlery, small pieces of electrical equipment, pots and pans. A limited quantity of dry and frozen food as well as fresh food brought in each day by pupils for their lesson[2]. Microwaves and combination ovens on trolleys and smaller pieces of equipment such as mixers, scales, food processors and electronic scales.
- **Textiles:** rolls and pieces of fabric, yarns, threads, boxes of small sewing accessories, weaving frames, sewing machines or over locking machines on a trolley. If 'wet' textiles activities take place there will also be items such as waxes, dyes and printing frames.
- **Electronics/Control,** a large range of generally small items: testing equipment such as multimeters, oscilloscopes. Material used for circuit boards, e.g. soldering irons, electronic components, structural and pneumatic kits, small sections of wood, metal and plastics. Mechanical components such as gears, pulleys and electric motors. PCB chemicals.
- **Multi-materials,** the bulkiest storage items: wood in sheets and sections; plastic sheets and rods; metal sheets, bars, rods and tubes. Tools for working these materials and mobile equipment such as a vacuum former. Flammable liquids, such as paints, thinners and solvents - quantities will vary from school to school. Cylinder gases (e.g. oxygen and acetylene) may be used in the heat treatment area.

3.13 Although certain materials and frequently used pieces of equipment can be kept in the teaching space, most items are best placed in store rooms in order to leave as much of the main space as possible available for teaching. A store room also allows expensive equipment to be locked away securely. A store of between 1.8m and 2.4m deep allows equipment trolleys to be stored down the centre of the room between wall shelving without wasting space. See Section 4 for more information on shelving systems. Particular points to note about the storage of specialist materials are listed below.

- Materials used in the multi-materials workshops are often stored in the preparation room (see paragraph 3.7). Where large quantities of timber are being stored for some time, it may be necessary to provide a separate unheated and permanently ventilated store which will maintain the condition of the material. However, as there is an increasing use of small timber sections and manufactured board and a quicker turnover of material, this is becoming less necessary. Metal always has to be kept dry.
- Bottles of oxygen and acetylene may be mounted on and chained to a trolley adjacent to the welding bench. Alternatively, the bottles may be kept in an external store and the gases piped to the bench. All these gases must be stored and handled with great care. The main points are outlined in Section 6 and BS4163 is a useful reference.
- Small amounts of flammable liquids may be stored within the building in specialist flameproof steel cabinets. Larger quantities must be stored externally in a steel, flameproof store[3]. When not in use the bottles must be kept in an area agreed with the fire prevention officer.

Notes
[2] The Food Safety Act 1990.
[3] BS4163: Code of Practice for Health and Safety in workshops of school and similar establishments 1984

- If food is kept in a storeroom there must be ventilation by means of a rodent resistant grille in the door or wall. Any cleaning materials or chemicals used for food science must be stored separately from foodstuffs.

Pupils' work in progress

3.14 Many pupils will keep an A4 file for written work and a portfolio (A3 at KS3 and A2 at KS4) for graphic work including sketches, photographs, computer print-outs and design drawings. These will be kept for reference and possibly assessment purposes. Although these records are space consuming they need to be stored within the department in a way that allows for easy access. Pupils' work may also be recorded on video. These tapes are likely to be kept by the teacher in lockable storage. Figure 3/4 illustrates the range of items which might need to be stored for each pupil.

3.15 Pupils will design and make products using a range of media. Projects may involve a combination of materials but products to be stored can be broadly described thus:

Food: few items of prepared food are likely to be kept for any length of time, even if bottled or frozen, but they may be photographed. These records can be stored in a portfolio.

Textiles: these objects may be bulky three dimensional constructions or flat lengths of printed fabric that can be folded, or they may be full length garments that need to be hung.

Wood/metal/plastic/electronic prototypes and final products: these will come in a variety of sizes and shapes and may be large. They may be kept in large plastic crates or directly on shelves. More space per pupil is likely to be needed at KS4. Space may be needed for both a prototype and a final product.

3.16 Walk-in stores, where items can be kept securely, are often best for storing project work in progress. However, files and portfolios are sometimes stored in the teaching space where they are more easily accessible. If suitably designed to ensure safety, the upper level of a room with a high ceiling can be useful for longer term storage. Large scale projects that are kept for assessment purposes can greatly increase storage requirements especially as both prototypes and final products may be stored. When calculating area needs it is important to consider both the schools' policy and the requirements of the examining boards concerning pupils taking finished work home.

Teaching materials

3.17 These will comprise exercise books and other stationery, text books, computer discs and video tapes which will all need to be kept securely. Some personal tools and equipment may also need secure storage. Many schools also have a collection of 'project resource boxes' for use in particular projects.

3.18 In addition to lockable filing cabinets, which may be in the staff base or teaching space, a secure store next to the staff base is recommended for keeping certain papers and expensive items of equipment such as video cameras and video recorders.

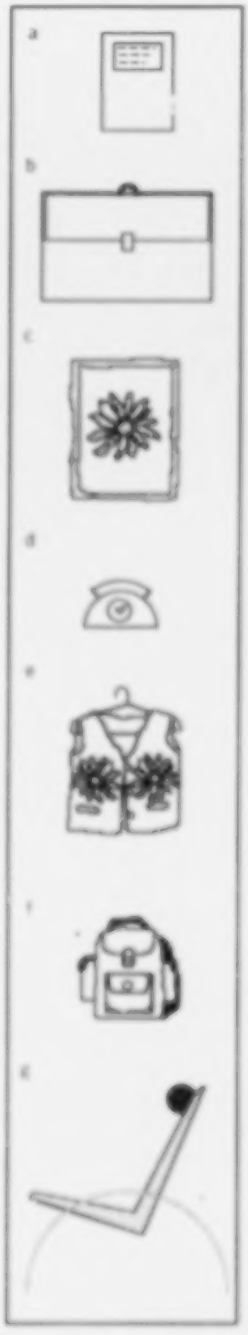
3.19 First aid equipment must be available in every teaching space. It must be kept securely but easily accessible to both staff and pupils in case of an emergency.

Pupils' coats, bags and protective clothing

3.20 Pupils' coats and bags are often stored in teaching spaces. When this is the case a specific area needs to be allocated for them. This should be positioned to avoid causing an obstruction, preferably near the entrance to the teaching space. A wall recess or a purpose made storage rack can be used (see Section 4). In the case of food rooms, it is preferable to store coats and bags outside the food preparation area, to avoid compromising the food hygiene standards.

3.21 Where protective clothing such as aprons or catering hats are used, they can be kept near the entrance to the teaching area. Goggles for machine use, however, should be kept adjacent to the machine (see Section 4).

Figure 3/4
The likely range of pupils work
a: File of research etc
b: Folio of design work etc
c: 2 Dimensional textile work
d: Control device
e: Textile garment
f: 3 Dimensional textile work
g: Large constructional item



Section 4 : Furniture and Finishes

This section describes the types of furniture which are appropriate for a broad range of design activities as well as some of the items used for more specialised activities. Information on internal finishes is also included, particularly where there may be health and safety implications.

4.1 Furniture provision is an important consideration when designing spaces that need to be adaptable enough to fulfil the wide requirements of design and technology. Design, investigation and evaluation activities may now take place alongside making within each specialist space (see Section 2). It is this wide range of activities which is providing challenges to the furniture designer and planner. Spaces within design and technology with a common range of furniture alongside specialist furniture create flexible environments which may be easily changed.

4.2 It is possible to choose a range of furniture for general design work that can be used in any room, regardless of its specialism. This has the advantage of making spaces more interchangeable. For example, if a dry textiles room becomes a graphics area the change over is more easily achieved if 50-60% of the furniture in that room is common to all spaces. This approach also gives the design and technology department a coherent appearance. This furniture rationale is reflected in all the plans illustrated in other sections.

4.3 It is strongly recommended that furniture items conform to the relevant British Standards as listed in the Bibliography.

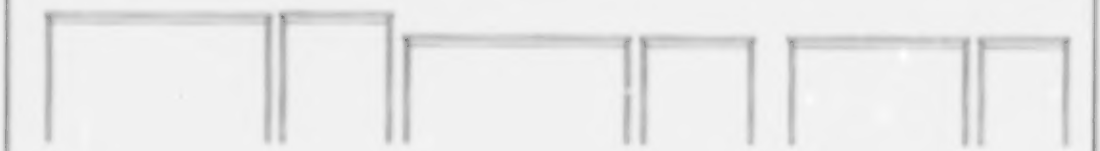
Tables and Benching (including work surfaces)

Basic Tables

4.4 Three basic table sizes are illustrated in Fig. 4/1; two table top sizes of 1500x750mm and 1200x600mm and two heights of 700mm and 850mm for seated or standing work respectively. These basic tables allow for a variety of activities, listed in Fig. 4/1. The 1200x600mm table at sitting height is a standard general teaching table. In the furniture and equipment layouts in other sections this table is used mainly in the design resource area because of the general nature of activities in that area. The larger table at both standing and sitting heights is shown in the practical areas where activities are 'light' duty, for example loom based work in the textiles area.

4.5 Work surfaces for these basic tables are generally plastic laminate over a manufactured board core. In food rooms where loose tables are part of the food preparation area they should be easily washable, water and heat resistant (most standard laminates would be suitable) with a fully sealed edging[1].

Note
[1] Food Safety Act 1990: HSE



STANDING (850 H)
1500X750mm
- Heavy duty practical work
- Light duty practical work
- Modelling
- Sketching
- Food preparation
- Product assessment
- Testing
- Fabric cutting
- Presentation
- Air brush work

SOLID OR STANDARD LAMINATE

SITTING (700 H)
1500X750mm
- Light duty practical work
- Modelling
- Drawing
- Sketching
- Painting
- Computer work
- Discussion
- Drawing board work
- Air brush work
- Presentation
- Investigation
- Cutting and pasting

STANDARD LAMINATE

SITTING (700 H)
1200X600mm
- Drawing
- Writing
- Discussion
- Computer work
- Seminar work
- Evaluation exercises
- Designing
- Drawing board work
- Presentation
- Investigation
- Reading
- Display

STANDARD LAMINATE

Figure 4/1
3 sizes of basic tables: their uses and typical surface finishes

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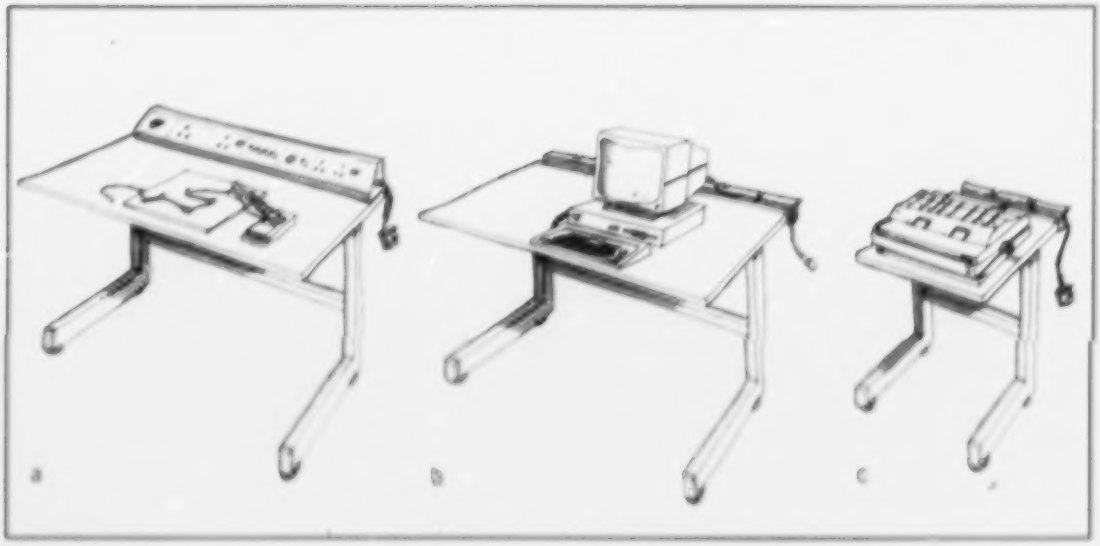


Figure 4/2
Specialist serviced tables
a: Serviced table (this example shows a full range of outlets, trunking may house electrical socket outlets only if power packs are used)
b: Computer table
c: Printer table

Specialist tables

4.6 These tables may also be known as 'heavy duty' tables. They are robust in construction, have large worktops and may be serviced or unserviced. These tables are generally used for more 'heavy' practical work and are available in both sitting and standing heights, although they are more commonly used at standing height.

4.7 Specialist tables are available with different metal underframes. Some designs incorporate built-in serviced trunking and/or a wire management system, some designs use an underframe on which trunking may be hung. The cantilevered underframe or 'C' frame shown in Fig. 4/2 is particularly popular as pupils can sit more easily at the front of the table without the restrictions of legs. Storage units may be rolled underneath and located against the bottom of the frame. When placed side by side these tables look less cluttered than those with four legs.

4.8 Serviced 'heavy duty' tables generally contain compartmented trunking. Fig. 4/2a shows a typical example, often called a 'technology' table, which is particularly useful in electronics/control rooms as it provides a full range of relocatable services without the need for permanent installations in the building. Services usually include low and extra low voltage electrical outlets, serviced by a single power point. Schools must, however, carefully consider the need for a full range of outlets on each table when planning a furniture and equipment budget. Certain activities may be done using a portable power pack at considerably less cost than outlets on every table. A compressed air supply may also be distributed using the trunking system. Some tables now have soldering outlets with extraction systems to remove fumes during the soldering process. These systems are available in varying degrees of sophistication. It is the responsibility of the school to assess the degree of risk to the pupils when soldering and to choose the type of table accordingly (see Section 6).

4.9 Serviced tables allow all types of activities to take place in the centre of the room and avoid the need to puncture the building with a large number of serviced outlets. The trunking enables a number of tables to be 'daisy chained' or linked together and serviced from perimeter service outlets[2]. However, the number of tables that can be linked in this way will depend on the power capacity of the socket outlet (see Section 6).

4.10 A 'heavy duty' table may also incorporate a cable tray for wire management (Fig.4/2b). The tray carries wires for 'daisy chained' computer tables. The work surface area should allow for the flexible arrangement of IT equipment and be deep enough to allow the keyboard to be placed in front of the VDU and for pupils to sit at least 600mm away from the screen[3], 750mm is usually sufficient.

4.11 As with most table construction, computer workstations must provide adequate

Notes
[2] BS 6396: Specification for electrical systems in office furniture and office screens BSI 1989
[3] Health and Safety (Display Screen Equipment) Regulations 1992: HSE

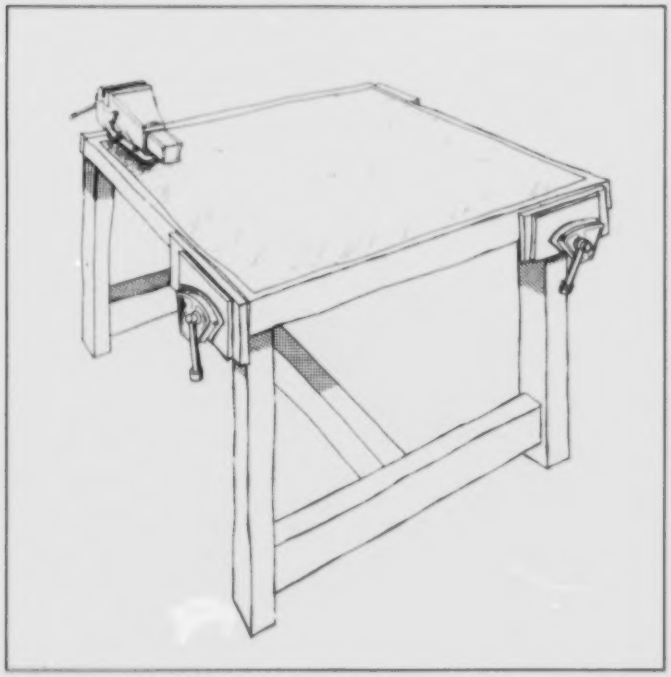
Notes
[4] "Making IT fit" video DfEE 1995
[5] Building Bulletin 62 Body Dimensions of the School Population 1985 DES HMSO

clearance for postural changes of pupils' thighs, knees, lower legs and feet. Allowing for a working height of 700mm the work surface and front rails should have a thickness no more than 75mm in total to enable thigh clearance. The use of adjustable chairs will also enable adequate postural clearance for pupils of varying sizes. Tables which are for use with computers should have a low reflectance finish to prevent problems with glare[4].

4.12 A small 'specialist' table with cable tray will allow a printer to link or 'daisy chain' from any computer table formation, see Fig. 4/2c.

4.13 Work surfaces for these tables are generally plastic laminate over a manufactured board core. Solid laminate could also be used, particularly in schools where mild strength chemicals or heavy duty work is taking place (e.g.: in electronics). Certain heavy duty, unserviced tables may have a linoleum top which provides a good, resilient general work surface for light activities. Table edge material should be sufficiently strong and well bonded as these tables may be subject to a good deal of heavy usage. For this reason some post-formed edges should be avoided as laminates can be very thin to allow them to form a rounded edge over a wooden core.

Figure 4/3
Robust Workbench



Robust work benches

4.14 As workshops become more multi-purpose, benches with both metal and wood vices (vices are available which may be easily changed to work with both wood and metal) and versatile tops are increasingly important, see Fig. 4/3. Tops for workbenches are often convertible and can be changed from solid wood to loose oil-resistant board for working with metal. Tools and other resources can be stored underneath in cupboard units. Where provision for drawing is limited, open benches will allow pupils to sit comfortably for drawing and design work. Open benches are also lighter and therefore easier to move in order to rearrange the workshop layout. Optimum heights for workbenches should be around 800mm[5]. This takes into account the height of vices, tools and materials used as well as the downward force often required when using hand tools.

Screen Printing tables

4.15 These are available in a variety of designs, but should always have a securely postioned soft foam top for placing fabric on. Owing to its size (often 2m x 1m), it is efficient in terms of space to choose a table with a reversible wooden and foam top which can also be used as a basic work surface. Some tables incorporate plan chests underneath, also resulting in efficient use of space. As with multi benches screen printing tables should ideally be between 800-850mm high. This range takes into account both the flat, two dimensional nature of the work and the downward forces required in printing.

Perimeter benching

4.16 Perimeter benching usually contains most of the room's services as well as providing additional work surface. A useful minimum depth for benching is 600mm, positioned at either standing or sitting height.

4.17 Where IT equipment is used on perimeter benching, a minimum depth of 750mm should be used. When wall mounted trunking (usually around 50mm deep) is used along the back of the benching an overall depth of 800mm should ideally be assumed, this takes into account both the depth of the trunking and the need to tidy away wires to the underside of the

benching. IT equipment should ideally be positioned on sitting rather than standing height benching. IT equipment on high benching is not generally considered to be good practise although it is sometimes unavoidable.

4.18 Where there are radiators, low windows or trunking careful detailing of benching may be required, particularly in adaptations. Fig. 4/4 shows two typical details. Fig. 4/4a shows a sitting height bench for computer use at a depth of 800mm which allows for trunking behind. Fig. 4/4b shows a standing height bench below a window. The trunking and bench are spaced away from the wall to allow for air movement above the radiator. The trunking runs below cill level. In food rooms, the increased height of stainless steel commercial catering units with in-built upstands must be allowed for when planning the height of wall based socket outlets.

4.19 Standard laminates can be used as a benching surface in most situations. However, in heavy duty areas such as workshops or in areas where mild strength chemicals may be used, solid grade laminates may be more appropriate. In food rooms, the surfaces of perimeter benching should be easily washable, water and heat resistant and, if fixed, fully sealed to avoid water penetration[6]. Laminated upstands should also be well sealed and preferably post formed in order to avoid water attack on edges where two glued laminate surfaces meet. Deeply scratched surfaces can harbour dirt and bacteria. Stainless steel which is hard and therefore difficult to scratch deeply is an ideal surface in commercial catering facilities due to the hygiene requirements in these areas. New synthetic surfaces are now available for furniture used in areas such as Food and Electronics. As the cost varies considerably the suitablility of these finishes should be carefully considered.

4.20 Systems are available which are made up of a series of octagonal work surfaces attached at 90° to perimeter benching (a peninsular arrangement). Services are carried through the furniture construction which means that power points may be brought up to centrally positioned octagonal units from the perimeter. These may be useful in the centre of the room when pupils are using powered equipment. The system is sometimes used for food rooms or electronics areas. Case Study 6, Section 7 shows an example of a food room layout using this system. It must be borne in mind that all the worksurfaces in this system are fixed which has disadvantages should the school wish to change the room layout in the future. A school may also wish to offer a range of work surface heights to accommmodate the needs of particular pupils (see Section 2, Food).

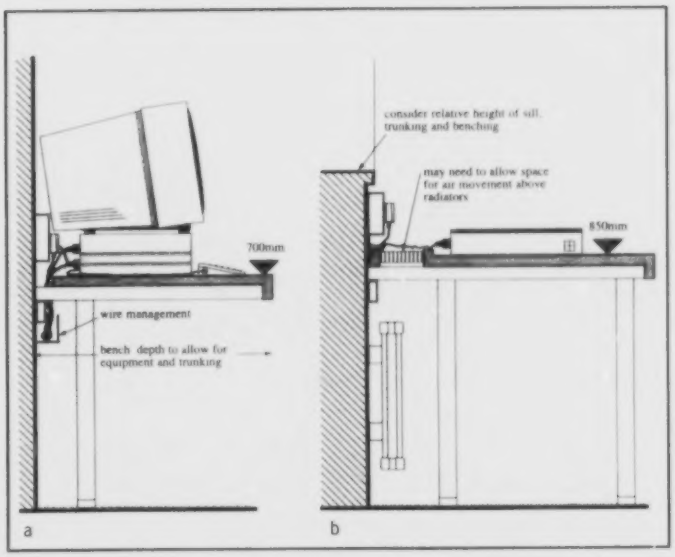

700mm
wire management
bench depth to allow for equipment and trunking
a
consider relative height of sill, trunking and benching
may need to allow space for air movement above radiators
850mm
b

Figure 4/4
Detail of benching and trunking
a: Trunking and sitting height benching on internal wall.
b: Trunking, radiator, standing height benching and cill on external wall.

Seating

4.21 Three types of seating are desirable to suit the diverse nature of design and technology: stackable chairs, stools and adjustable chairs. Stackable plastic moulded chairs are particularly useful as they are inexpensive, relatively easy to clean and lightweight. When used with loose tables they can be moved to allow an area to be cleared for group activities. Stools are generally used with standing height tables. Ergonomically shaped or moulded plastic or wooden seats are preferable as they are more comfortable.

4.22 The ability to adjust seat height is particularly advantageous when computers are being used[7]. Fully adjustable chairs (both seat and back) enable pupils to position themselves correctly to ensure their eye line is in a suitable position in relation to the computer screen and to rest their wrists comfortably at the key board positioned on the table top[8]. Footrests are advisable where pupils are unable to rest feet flat on the floor, this is particularly relevant where computers are placed on standing height benching[7 & 8]. Where stools are used with standing height benching backs and footrests should be provided.

Notes
[6] Food Safety Act 1990 HSE
[7] Health and Safety (Display Screen Equipment) Regulations 1992: HSE
[8] 'Making IT fit' video DfEE 1995

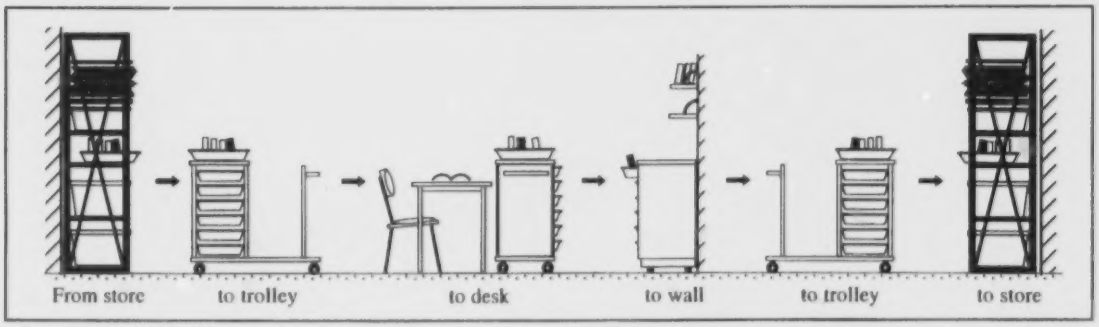


Figure 4/5
Transportation of resources

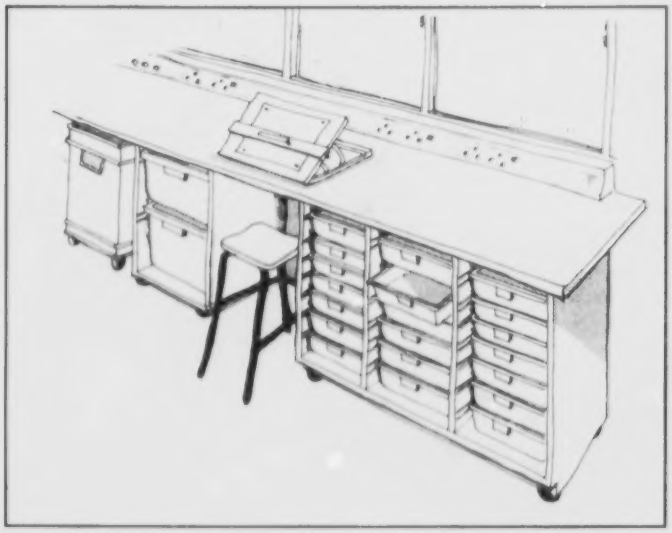
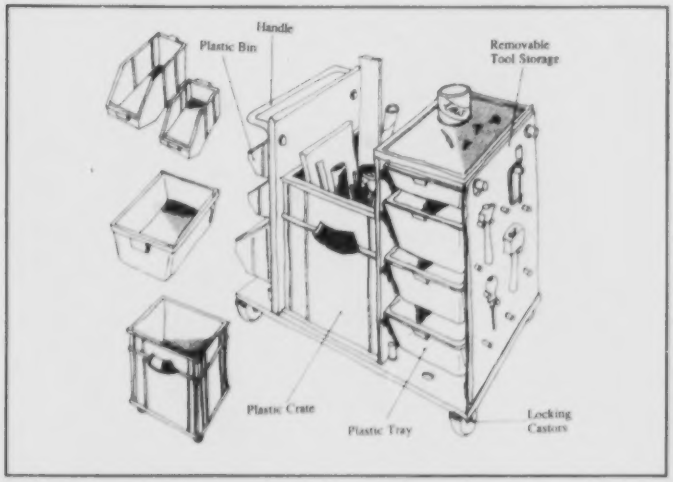


Figure 4/6
Mobile storage and perimeter benching

Figure 4/7
General resource trolley



Storage Systems

4.23 Compatible storage units across all areas of design and technology allow the spaces to be used efficiently and flexibly and resources to be shared (see Fig. 4/5).

In Teaching Spaces

4.24 A system of mobile cupboard and tray units avoids the problems associated with underbench fitted cupboards. The latter are often inaccesible and as a result remain empty. Mobile storage may be 'rolled' under a perimeter worktop and moved to the centre of the room when required. These units may also be moved if pupils wish to sit at the perimeter worktop, (see Fig. 4/6).

4.25 Mobile units should ideally relate to any static units in the room and could be part of the same range. Static units include tall cupboards (which are good for high volume storage particularly if storeroom space is tight), low cupboards, tray units or plan chests. These cupboards can provide additional work surface, display area and space division. Tall units can however, cause accoustic problems where sound hits hard laminate surfaces. Both mobile and static units may contain standard plastic trays to increase the interchangeability of furniture and the resources stored in them, (see Fig. 4/5). Lockable static storage units should be used to house valuable resources.

4.26 There are many types of trolley available which integrate with storage units. These are particularly useful in storing and transporting small amounts of resource material to the classroom. These trolleys may contain plastic trays which can be changed between compatible storage units within the classroom, storeroom and preparation area (see Fig. 4/7). It is important to allow enough space for

trolleys to stand in the storeroom (see Section 3). Resources such as hand tools and various materials can be loaded onto the trolley from the surrounding shelving and then wheeled into the classroom ready for the lesson.

4.27 Resource trolleys are useful in multi-materials spaces as they enable pupils to gain experience of a wide range of hand tools and constructional materials without entering the heavily serviced preparation area. Crates and bins complement this approach. They can be stored on trolleys or placed on shelves in storerooms to contain pupils' work in progress. The larger containers may be mobile and can be wheeled under benching or tables (see Fig. 4/6). Small plastic bins may be clipped onto the wall via a fixed metal louvred panel. This allows pupils to choose from a wide range of resource materials.

4.28 Some personal protective equipment must be stored in teaching spaces to ensure pupils have access to them at all times. For example, goggles and protective aprons should ideally be kept alongside machines in multi-materials areas. This storage should be clearly marked and the equipment protected from loss, contamination and damage from damp or sunlight[9].

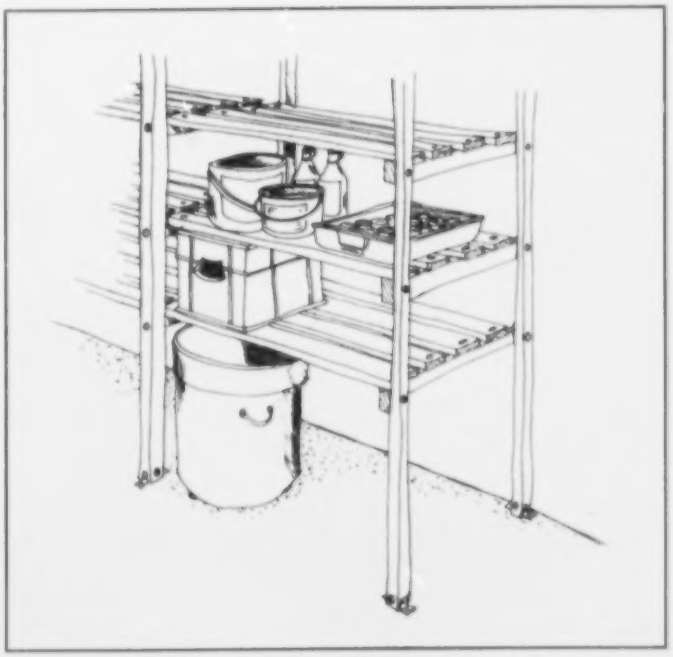
4.29 If pupils' coats and bags are to be brought into the teaching spaces then they must not cause an obstruction. A defined unit or area could be provided, preferably placed next to the room entrance. Storage could be in the form of a free-standing softwood or steel unit with hooks and bags shelf underneath. Alternatively a unit or row of pegs could be attached directly to a wall or alcove. Loose units are a more flexible app-roach allowing for re-arrangement of the room. In food areas it may be necessary to provide storage for aprons and hats for hygiene reasons.

In Storerooms

4.30 There are many types of bulk storage systems, with varying levels of flexibility. The four main options are:

- **Purpose built fixed timber batten**. This shelving can reduce flexibility but allows shelves to fit accurately into a storeroom, (see Fig. 4/8).

Figure 4/8
Purpose built fixed timber batten shelving
Figure 4/9
Adjustable height timber shelving



Note
[9]Personal Protective Equipment (PPE) at Work Regs. HSE 1993

Notes
[10] Manual Handling Operations Regulations HSE 1993

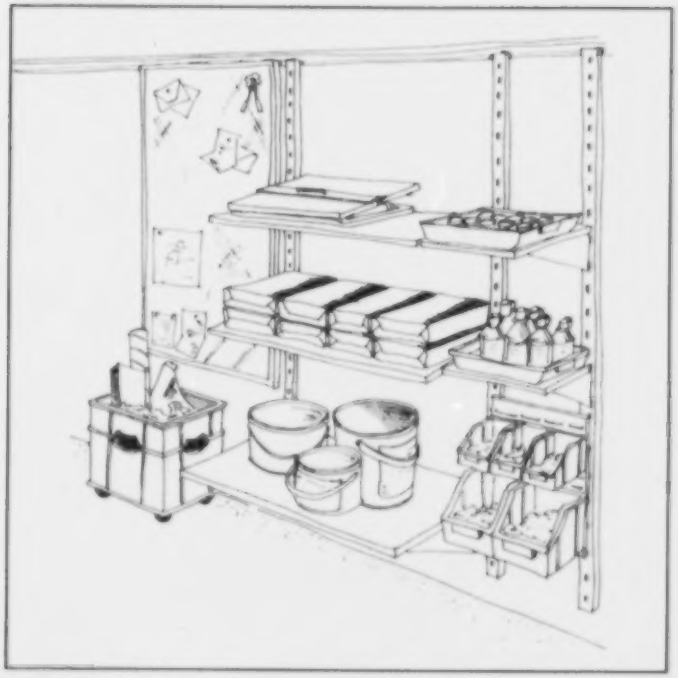
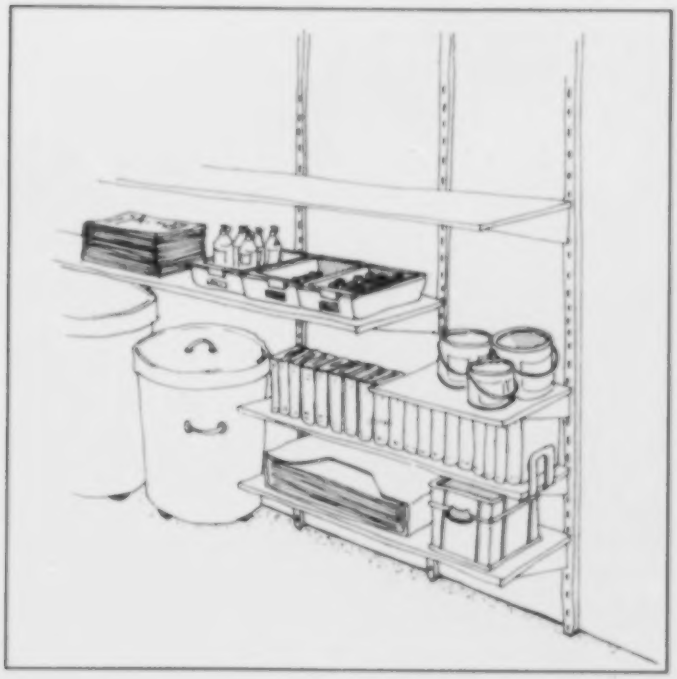


Figure 4/10
Top hung storage

Figure 4/11
Cantilevered bracket storage



- **Adjustable height timber shelving**. This shelving can be free-standing. However, it is more usually fixed back through the frame to the wall. Re-locatable pegs allow shelves to be adjusted, which provides greater flexibility than fixed batten shelving, (see Fig. 4/9).
- **Top-hung storage**. This system is suitable for both storerooms and classrooms. It incorporates a wall mounted shaped metal section from which droppers and shelves may hang at any point. Very lightweight walls may not be suitable for this system, (see Fig. 4/10).
- **Cantilevered brackets** in fixed metal droppers. This adjustable system is also suitable for storeroom and classroom use and enables shelving to clip in at various heights, (see Fig. 4/11).

4.31 To ensure safe manual handling operation the user should be able to see and assess the weight of a stored item easily[10]. For this reason shelves should not be too deep so as to prevent this assessment. The heaviest loads should in any case be stored at waist height where removal is easiest and safest. Sufficent shelving should therefore be provided at this level. High level storage of heavy items should always be avoided. Adjustable shelving allows shelves to be positioned at the optimum height for the load it is storing and the height of the person who is mainly working in the area.

4.32 Storage units specifically for portfolios or work folders are available for storerooms and teaching spaces. A series of hooks are held within a metal frame from which folios can hang. This offers the teacher a clearly organised storage system for pupils' work which can be readily accessed. When considering the cost breakdown of the furniture and equipment budget schools will need to be sure of the advantages of this system compared to, for example, plain shelving divided up by sheets of hardboard. A trolley system is available for the storage of desk-top drawing boards enabling them to be wheeled easily from the storeroom. Again, a cost analysis must be done for this system.

In Preparation Areas

4.33 After delivery, materials such as wood and metal are prepared (cut down into manageable sizes, planed etc.) in a defined area and it is here that the majority of these materials are often stored (see Section 3). In the example in Section 3, a variety of storage facilities are shown. These include racking for raw materials, tray and bin storage for small items such as screws, nails and tacks and lockable storage cupboards for hand tools. There are specially designed units for storing small components which can be placed on trolleys for use in the workshops.

4.34 Fig. 4/12 shows the types of storage required by various materials. Ideally, metal rods and timber planks should be stored horizontally against the wall on a series of metal brackets and secured with safety chains to ensure the material is securely positioned on the shelves. It must be borne in mind that this system relies on the solid construction of the wall. Free standing frames are available as an alternative. In order to maximise the use of valuable wall space, metal rods and tubes may be stored horizontally above the hacksaw (no less than 1300mm from the ground so as to accommodate the hacksaw head in a raised position).

4.35 Sheet materials, which include manufactured wooden boards, metals and plastics are ideally stacked vertically in a rack. The rack may consist of wooden boards or tubular metal rails forming compartments.

4.36 The position of racking must be carefully considered as the metal sheets have sharp edges and could be a hazard when pulled away from the racks. For this reason they should be placed well clear of doorways. Adequate space must be allowed for safely manoeuvring sheets which may measure up to 2400mm in length (see Section 3). Material of any type must not protrude from its racking. Storage facilities should be large enough to store standard sizes of materials.

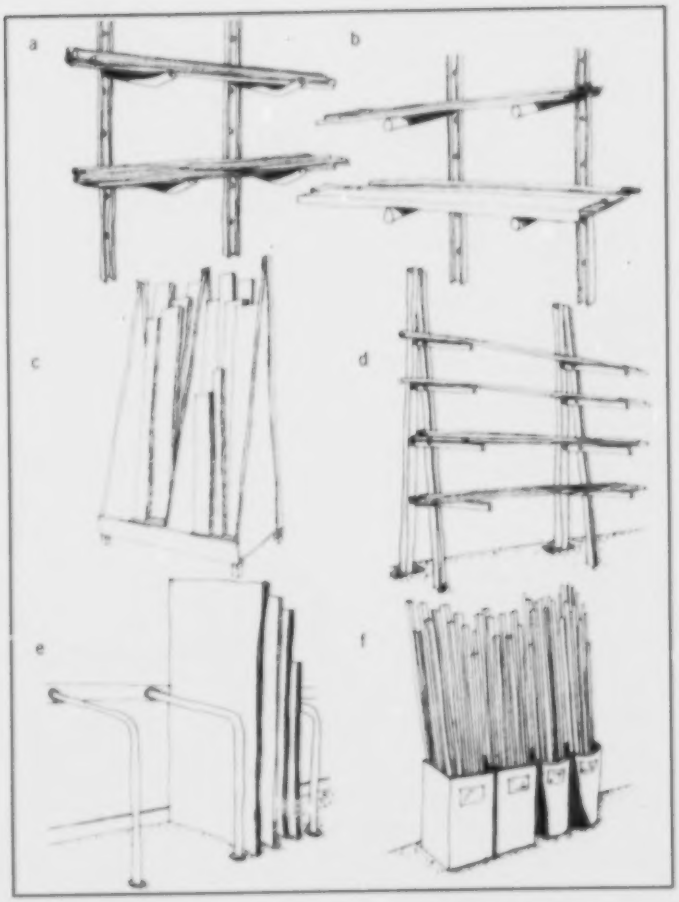


Figure 4/12
Storage methods for raw materials in Preparation Areas
a: Rod and tube storage using steel channels on the wall and angled 'arms' to prevent rolling.
b: Similar method for the storage of timber planks.
c: A movable unit with compartments for the storage of timber sheets or planks.
d: Steel units, usually bolted to the floor may be placed at intervals for the storage, mainly of steel rod and tube, double sided units are also available.
e: Tubular steel 'fences' divide up wall space into compartments for the storage of sheet material.
f: Individual sturdy tall containers can be used to organise and store different types of materials, here square and round section steel are stored in the drums and round and square section tube in the square boxes.

Display

4.37 Display is an important aspect of the classroom environment providing pupils with both visual stimulation, a sense of achievement and information on specific processes and materials.

4.38 Main display can be provided on walls in the form of top hung boards or permanent pinboard wall covering. The backs of storage cupboards can also provide useful vertical display surface. Tables and cupboard tops provide horizontal surfaces for displaying three dimensional objects.

4.39 Display is also important in presenting the department's work, particularly in centrally placed resource areas and corridors. These resource areas are often enclosed by low screens which provide both space division and additional vertical surfaces for display.

Room Finishes and Fittings

4.40 Surface finishes and fittings should be chosen to ensure a practical and safe teaching space. In addition, they can be used to create an attractive and stimulating environment. For example, graphic symbols and colour can be used to make the space more 'user-friendly' as well as more attractive.

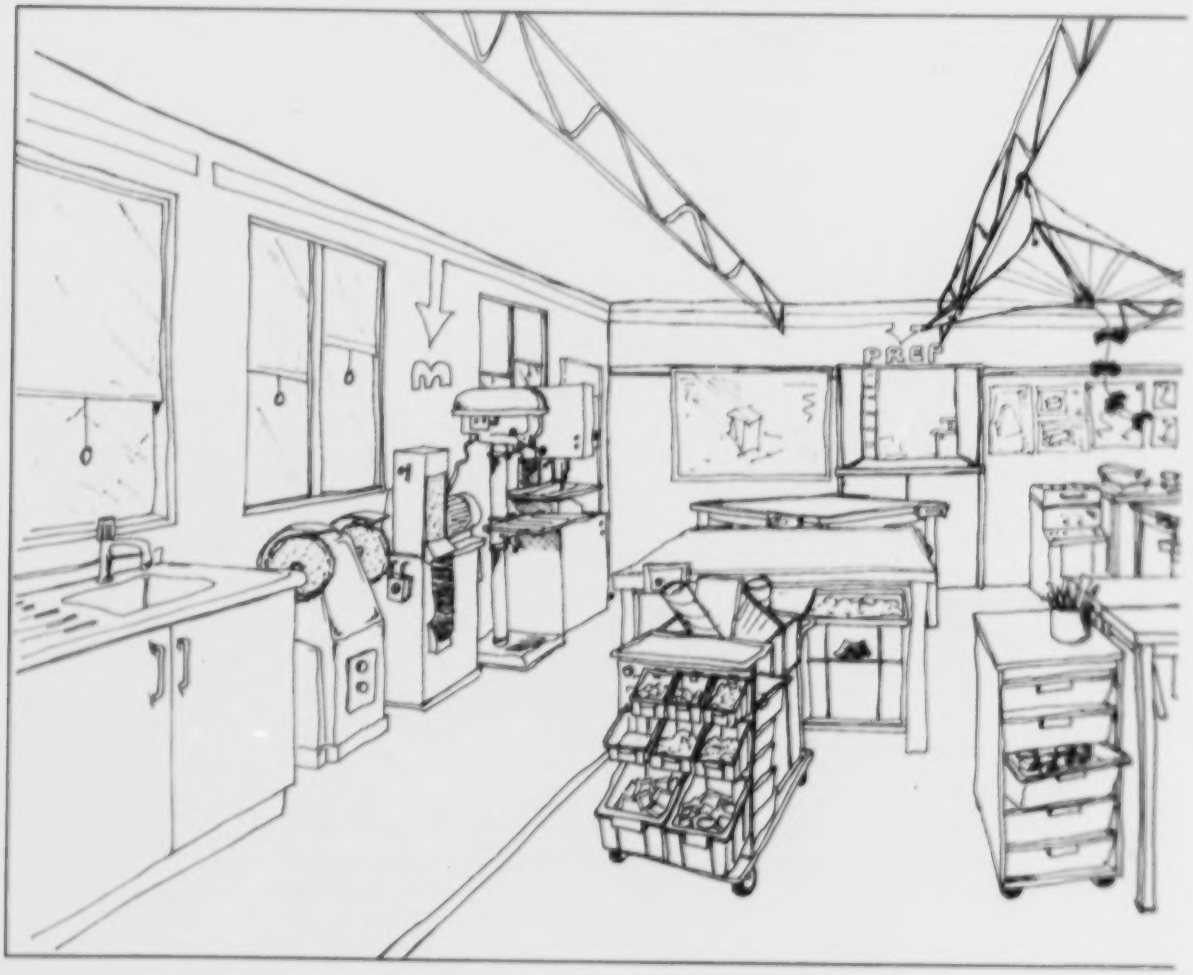
4.41 Fig. 4/13 illustrates ways in which a multi-materials workshop can be made into an exciting space which may prove attractive to pupils who might otherwise be unhappy or unsure in a workshop environment. Some of the main points are outlined in the following paragraphs.

Floors

4.42 Floors should, as far as possible, be at one level. The surface should generally be slip resistant and, particularly in food rooms, easily cleaned. In the heat treatment area the floor should be fire resistant. It is important that all floors are well maintained and kept free of obstructions.

4.43 In a multi-material workshop a change in floor finish or floor colour can be used to define a heavy duty work zone, (for example a heavy machine area) which is useful for Health and Safety reasons. Similarly yellow floor markings are often added in the multi-material workshop to denote a separate machine area. These may be preferable to guard rails as it allows pupils to move away quickly in the event of an accident.

Figure 4/13
Perspective drawing of multi-material area.



Walls

4.44 Walls should be smooth with a high level of light reflectance and, particularly in food rooms easily washable[11]. Tiles may not be the best choice in food rooms as they can crack and grouting can often harbour bacteria. If they are to be used larger tiles are preferable to smaller ones.

4.45 Coloured lines and labels can be used on walls to denote certain activity areas and allow pupils to see immediately which activities are on offer and where.

4.46 Large models may be suspended from the ceiling or from exposed beams. Hanging flameproof panels vertically from the ceiling, (for example glass panels around the heat treatment area) could define the area without actually placing anything permanently on the floor.

Furniture and Fittings

4.47 Blinds are useful as a protection from glare and can bring colour into the space. Wall tracking systems allows displayboards, whiteboards and storage to be hung where the teacher chooses. Coloured trolleys, crates and bins on wheels allow pupils to access resources where and when required.

4.48 In multi-materials workshops painted symbols can be used on machines to denote their material bias/es (i.e. triangles on machines for use with wood, circles for metalworking machines). This allows pupils to feel familiar with the machine without necessarily having used it.

Note
[11] Food Safety Act 1990 HSE

29

Section 5 : Equipment

This Section gives a brief description of the equipment featured in the room layouts throughout this publication. Some of the key planning and health and safety issues are also outlined. Further guidance regarding safe working distances around these machines is provided in Appendix 1.

5.1 The equipment shown on the layouts in this publication is not based on a particular manufacturer. Therefore details such as size or electrical specification are not shown. Information is given only when it has relevance to the accommodation of that machine. Further information on general points such as the safe installation of machinery and guarding is given in Appendix 2 and the Bibliography.

5.2 It is important that all health and safety regulations (listed in the Bibliography) are considered when designing accommodation for design and technology. Workshop safety is largely achieved through good workshop management, training and careful supervision of pupils by teachers and technicians. Further guidance on associated services is given in Section 6.

Wood Working Machinery

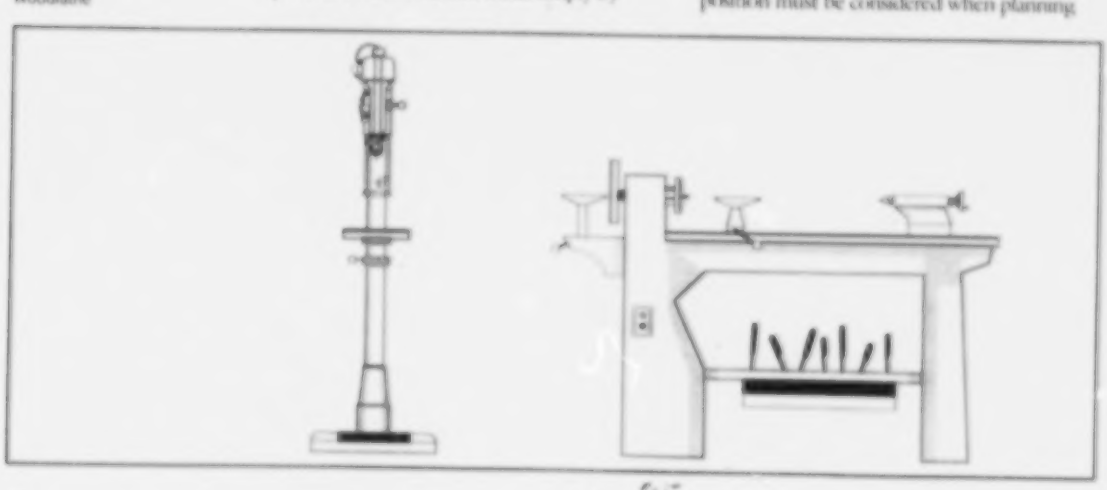
Pillar Drilling Machine

5.3 Generally the most heavily used machine in a workshop, the pillar drill can normally be used for both wood and metal simply by changing the drill bit and the speed of the machine. Sometimes two pillar drills can be provided in one workshop reducing the need for this operation. Large pieces of material may require drilling and space around the machine should be provided for this at drill table level. If the material is not clamped tightly onto the table during the drilling operation then it could spin round with the drill bit. Providing sufficient clear space around the machine will reduce the likelihood of a serious accident if this should happen. A foot or knee operated switch should be fitted on the drill as an additional safety feature. An isolator switch should also be provided on or adjacent to the machine.

Wood Lathe

5.4 A woodlathe rotates a piece of timber whilst a chisel or scraper is offered up to the wood at various positions in order to 'turn' the material down (i.e. reduce in size) and shape it. A bowl or a table leg are examples of items made on a wood lathe. Ideally it should be placed at the end of a run of machines away from the major 'traffic' of the workshop. Woodlathes can be placed parallel to a wall or preferably (if there is room) at an angle (15°) to the wall. This gives the operator greater protection from the circulation route. Some lathes may have an additional face plate facility (for bowl turning) attached to the end of the machine. In this case the extra operator position must be considered when planning

Figure 5/1
Pillar Drilling Machine
Woodlathe



the workshop. Due to the precise nature of operation this machine requires a good level of natural light.

5.5 Local dust extraction above the lathe is not normally required, the amount of dust given off during operation may be minimised by the use of well maintained tools. However, if a school should wish to use composite materials in a woodlathe suitable dust extraction units should be installed. An isolator switch should be provided on or adjacent to the machine.

Morticer

5.6 A hollow chisel type morticer will cut square shaped holes in wood using a manual lever which lowers the chisel to a pre set depth. It is mainly used to make mortice joints for furniture construction and larger structures. Given the wide range of objects made in school workshops today this machine may not be as used as much as it once was. A foot or knee operated switch should be fitted on the morticer as an additional safety feature. An isolator switch should be provided on or adjacent to the machine.

Sanding Machine (Linisher)

5.7 Sanding machines are available in two basic forms; a rotating disc or a continuous moving horizontal or vertical belt (linisher). The vertical position is generally considered a safer option.

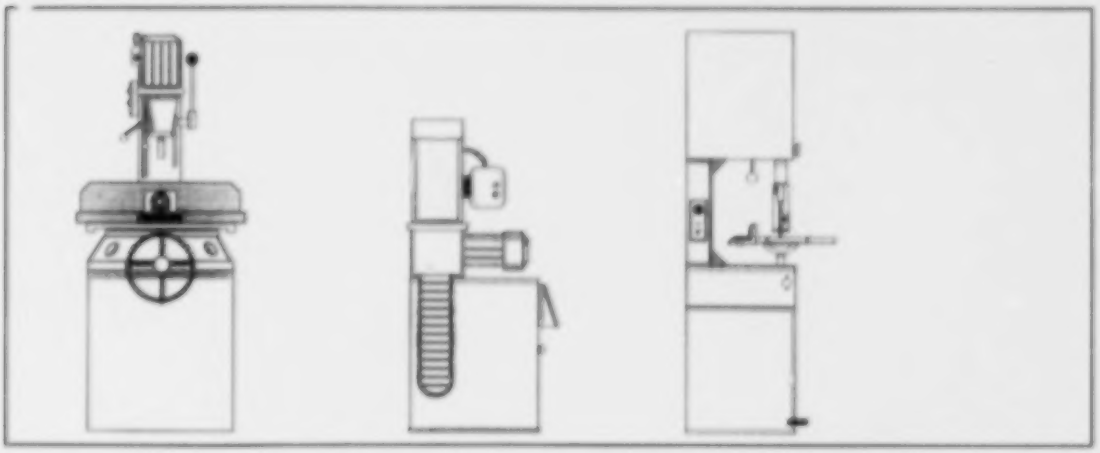
5.8 The sander is a suitable machine to place adjacent to a fire exit as the material being sanded is not clamped to the machine and therefore would not obstruct the fire exit in the case of an emergency. Separate local extraction should be provided for sanding machines, although some extract systems may be built into the machine, particularly the linisher. For further information on the safe extraction of wood dust see Section 6. A foot or knee operated switch should be fitted on the linisher as an additional safety feature. An isolator switch should be provided on or adjacent to the machine.

Bandsaw

5.9 The bandsaw, which cuts plastic, timber and sometimes metal, can be very useful in smaller schools where space does not allow for a circular saw. This machine may be used by older, responsible pupils under supervision (this is, however, a policy set by an individual school or authority) as well as by teachers or technicians. The machine is ideally sited in the workshop as it is frequently required throughout the lesson.

5.10 A bandsaw needs sufficient floor area to allow long lengths of wood to be taken through it. With the increasing use of composite and plastic boards extraction should ideally be provided on the bandsaw.

Figure 5/2
Morticer
Linisher
Bandsaw



Where extraction is ducted to one dust unit (usually positioned in the preparation area) it is useful to position the bandsaw as near to the preparation area as possible in order to reduce the length of ducting. As this machine is more useful in the workshop a key operated switch should be provided to lock off the machine when not in use. A foot or knee operated switch should be installed on this machine. A foot braking device is sometimes provided on these machines to prevent the saw blade snapping when the stop switch is operated. An isolator switch should also be provided on or adjacent to the machine.

Circular Saw[1]

5.11 The circular saw has a large rotary blade which can cut down large sheets of manufactured board and timber. The saw may only be used by a technician or teacher who has received recognised training. Due to the nature of the machine it should be kept in a separate area away from pupils (where the user will not become distracted during operation) and fitted with a key operated isolator switch. A foot or knee operated switch should be fitted on the saw as an additional safety feature. The sheet material sometimes used with a circular saw requires a substantial amount of space at saw table level for operation (see Section 3). A 'take off' table should always be used when large sheets are being processed as the saw table itself is generally inadequate to support full size sheets. The distance between the blade and the back of the saw or 'take off' table must be no less than 1200mm. Schools with limited space may find a small saw model with a portable side or extension table (for handling wider sheet lengths) a space saving method.

5.12 Local exhaust ventilation must be provided for this machine if it is used frequently. Some rigidly constructed exhaust units will sit adjacent to the machine and provide a 'take off' table surface as well. Where a circular saw has to be used in a workshop it must be used at times when other dust producing machines are not in use. The floor in the area where the saw is housed should be level, non slip and well maintained.

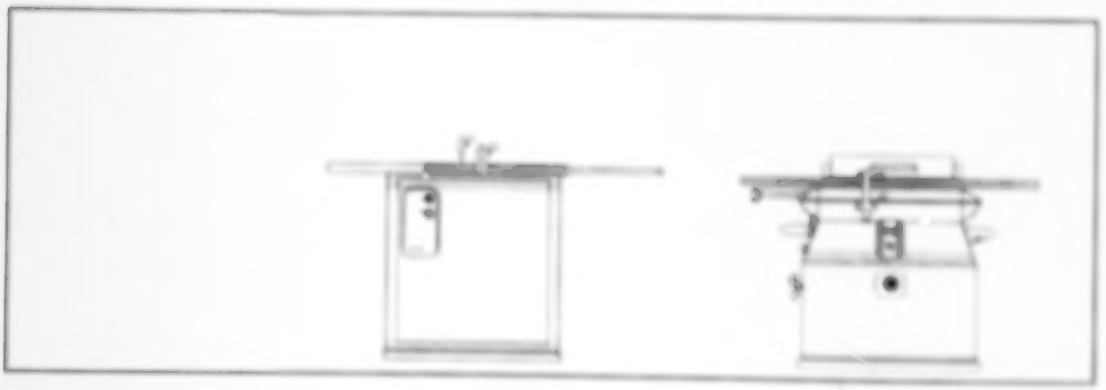
Planer/Thicknesser

5.13 Planer/thicknesser machines have two main functions: to produce true planed faces on sawn timber (planer) and to take a specific pre-set thickness from the surface of a piece of timber (thicknesser).

5.14 These machines can help reduce the cost of materials by recycling timber which may require reducing or surface finishing. Schools must ensure, however, that such material is free of any additional components such as screws or nails. As with the circular saw, the planer/thicknesser should ideally be housed in a separate area (preferably a preparation room) free from distraction and used only by a trained member of staff. The machine should be fitted with a key operated isolator switch. A foot or knee operated switch should be fitted on the planer as an additional safety feature. When sitting the

Note
[1] *Circular saw shown without take-off table*

Figure 5/3
Circular saw
Planer/thicknesser



machine in the preparation area consideration must be given to the length of material going through or over it. Local exhaust ventilation must be provided for this machine. Some schools may use a planing machine only.

Metal Working Machinery

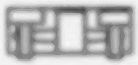
Metal lathe

5.15 A metal lathe rotates metal or plastic rod at the same time as a tool cuts into the material at various pre set positions. As with a woodlathe, a metal lathe may be placed either parallel with the wall or at an angle to it. The latter position is helpful when a teacher is demonstrating the working of the lathe and pupils are required to gather around the machine. The lathe is a precision machine and should be placed in a position with a good level of natural light. Additional task lighting is usually built into the machine. Metal may need to be fed into the chuck through the head stock for certain operations and this should be borne in mind when determining the space around this machine (see Appendix 1).

Milling Machine

5.16 This machine can be used to make slots, grooves or flat surfaces. Using a pre set rotating cutter position a milling machine accurately removes the surface from a piece of metal placed on a traversing bed. The moving bed means that the position of the machine must be carefully planned. The moving table should not be within 500mm of any fixed structure (see Appendix 1). As a precision machine it is best sited adjacent to its counterpart - the metal lathe.

Double Buffing Machine

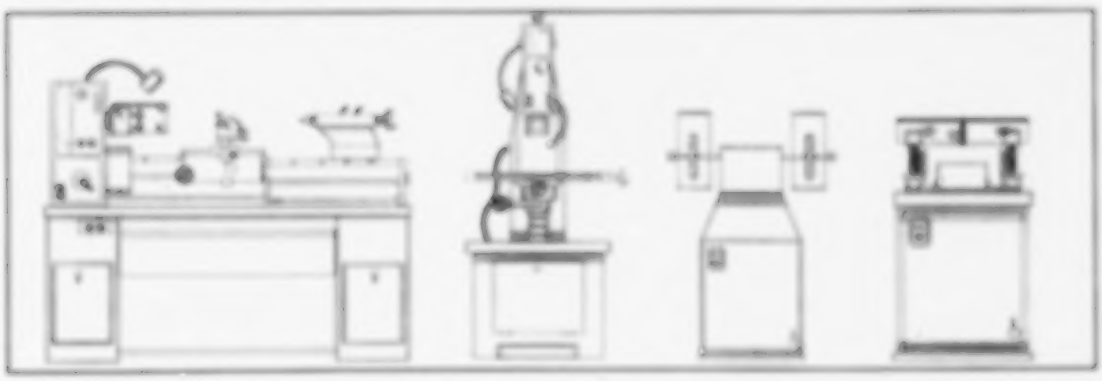


5.17 Like the linisher this is an appropriate machine to position adjacent to a fire exit. Metal and plastics are held against the rotating mops (generally made from stitched calico) and polished. Some manufacturers now make buffers with in built extraction to collect particles from the mop and fumes from the polish produced during the buffing process. There should be no exposure to the rotating shafts upon which the mops sit, these should be adequately guarded. If the machine will be used frequently, extraction is recommended.

Off-hand Grinding Machine

5.18 Most grinders have two rotating disks of grindstone about 15mm in thickness. Pupils may use this machine when adequate supervision and instruction is given. However, it is generally used by teachers and technicians for maintaining drills and lathe bits and is therefore best sited in a preparation area.

Figure 5/4
Metal lathe
Milling Machine
Double Buffing Machine
Off-hand Grinding Machine



Hacksaw

5.19 Usually placed in the preparation area this machine will cut metal bar and large tube. The saw blade moves slowly back and forth whilst the metal remains clamped. A mobile stand may be needed to support the metal particularly when cutting down the standard 3 metre lengths of metal which are often delivered to schools. Space must be provided around the machine in order to cut the metal at various points along its length.

Horizontal Grindstone

5.20 This machine will sharpen tools such as chisels on a rotating circular flatbed of grindstone. It is not necessary in teaching areas and, due to the nature of operation it is therefore best sited in the preparation area away from main circulation areas.

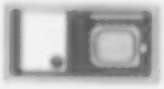
Hot Metal Equipment

5.21 Careful consideration must be given to the siting of all hot metal equipment because of the dangerous nature of the activities. It should ideally be placed in a separate area positioned for good supervision, free of oil, grease and dirt with a non reflective wall finish. Extraction should be provided for all hot metal equipment (see Section 6). The floor to the heat treatment area should be fire resistant and slip resistant. A surface on which to leave hot metal to cool should be provided as near to the heat treatment area as possible. Gas solenoid protection should be provided in the main gas supply should there be a failure of the electricity and (as a result) air supply.

Welding Bench

5.22 This is usually housed with the chip forge, brazing hearth and crucible furnace. Welding may be serviced via bottled oxyacetylene gas or electricity. Electric arc welding requires specific shielding facilities in order to avoid flash blindness. Gas (oxyacetylene) welding is widely used, some LEAs have a policy not to use electric arc welding. A flame resistant curtain around the bench is necessary to protect other pupils from seeing the arc (which causes flash blindness) and from sparks emitted during arc welding.

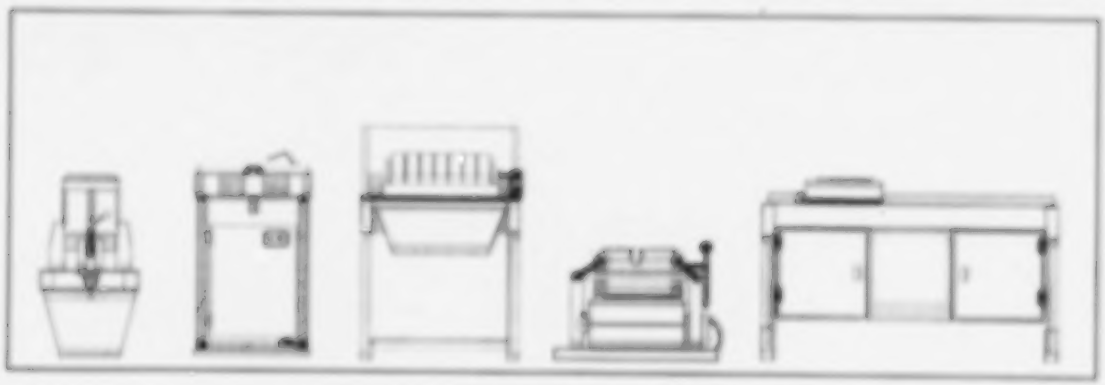
Crucible Furnace (& Moulding Bench)



5.23 These items may be housed with other hot metal equipment. Metal is melted in a pot (the crucible) and subsequently poured into a mould, constructed usually from sand. The furnace must be kept well away from water, as contact can cause the molten aluminium or zinc based alloys used in the

Note
* Extractor hoods not shown on heat treatment equipment diagrams

Figure 5/9
Hacksaw
Horizontal Grindstone
Welding Bench*
Crucible Furnace*
Moulding Bench



furnace to explode. A sand tray beneath where molten metal is poured contains any spillage. To reduce the dangers associated with an explosion the furnace should be placed in a corner. This prevents pupils standing against all four sides of the furnace. As casting will always be demonstrated or supervised closely by the teacher, there should always be sufficient space available for pupils to observe the procedures.

5.24 A moulding bench may be used in conjunction with the furnace. The bench consists of a deep tray of sand inset into a bench top in which a mould can be constructed. As pupils will be required to fill the mould with sand and lift it from the bench, the table should be no higher than 800-850mm. The deep tray has a cover over it to prevent the sand drying out. The bench should ideally be placed next to the furnace to enable pupils to construct a mould and take it to the furnace where the molten metal can be poured into it directly.

Brazing Hearth

5.25 This is a popular appliance for hot metal working, including jewellery making. The hearth enables pupils to join two pieces of metal together with spelter or silver solder heated by a gas torch (mains or bottled). Double units are available for schools with a large heat treatment area. These units use less floor area than two separate hearths and are generally less expensive. A water trough or low level sink for quenching hot metal should be provided near to the hearth.

Chip Forge

5.26 This is used to heat metal (usually steel or iron) to red heat in order to manipulate it. The heat is generated by gas burners and is passed through a layer of ceramic chips. The hot metal is usually shaped on an anvil and space should be allocated near the chip forge for this purpose. A trough or low level sink for quenching hot metal and a rack for associated tools should be provided nearby.

Combined Brazing Hearth/Chip Forge

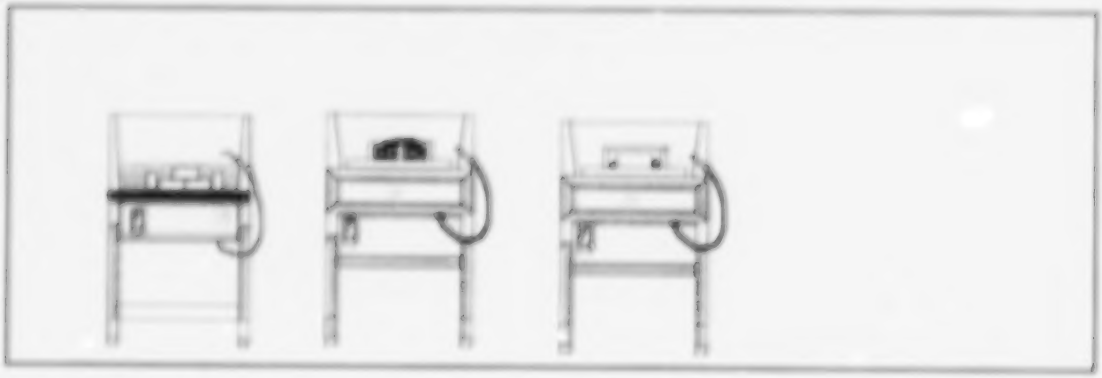
5.27 A combined unit with an inter changeable work surface which will achieve both brazing and forging is particulary useful in small schools. A space saving double unit with a separate hearth and a forge is also available.

Pickling Bench

5.28 A pickling bench allows pupils to clean metal after various heat treatment processes. The bench should ideally be no

Note
[1] Extractor hoods not shown on heat treatment equipment diagrams

Figure 5.6
Brazing Hearth[1]
Chip Forge[1]
Combined Brazing Hearth/Chip Forge[1]



higher than 850mm to allow for safe use by the smaller pupil. A sink and a tank (containing dilute acid) is inset into the bench. The acid will clean or 'pickle' the metal whilst the sink provides running water for rinsing. The pickling bench should be sited in a well ventilated area. The acid bath should come with a protective cover to prevent splashes. A large dilution trap is often provided which will enable the bench to be plumbed into mains drainage.

Bench Mounted Machines

5.29 The information above on the function of pedestal machinery also applies to bench mounted machines. A bench mounted machine needs the same guards, extraction, safety switching and braking as a pedestal machine. The area required at the side of the machine may be smaller than that needed by its pedestal counterparts as material used in the machines is not generally as large (see Section 2, Multi-materials). Leads to bench mounted equipment should not trail across the benching as this may present a safety hazard. Space should be allowed for the operator at the front of the bench (see Appendix 1).

5.30 The depth, height and construction of the bench is an important consideration. If the emergency stop buttons for the whole room are set on the wall both the pupil and teacher must be able to reach them in emergencies. If the buttons are set on a bench wall the work surface should be no more than 600mm deep to enable pupils and staff to reach the switches. Given the significant height of some bench mounted machines the bench should be no more than 850mm high to enable safe use of equipment by younger pupils. An additional safety measure for all machines is a cut-off switch clearly accessible to the operator which can be used in the case of emergencies. These switches should be provided for bench mounted machinery on the rail beneath the bench top or on the floor slightly under the bench so as not to be a tripping hazard. This does however, assume permanently sited bench mounted machinery.

Plastics Equipment

5.31 All plastics equipment should meet the relevant Health and Safety requirements. Plastics give off toxic fumes when overheated, but a built in thermostat to control the temperature of the equipment will reduce the risk of this occuring. Equipment should always be sited in a well ventilated part of the workshop such as near a window, see Section 6. When it is not in use the mechanically ventilated heat treatment area can be used for some plastics activities, sufficient power supply should therefore be provided in the area to enable plastics equipment to be used.

5.32 There is wide variation in the size of plastics equipment and schools must consider the space available in the workshop when deciding which items of equipment to purchase. There should always be sufficient space for safe and effective working.

5.33 A **vacuum former** uses atmospheric pressure to suck plastic sheet over a mould to form a 3 dimensional impression.

5.34 Formers vary in size depending on the size of mould used, from a bench mounted model to a larger floor standing model on castors. Some have lids which slide backwards and need to be positioned away from the wall when in use. This should be borne in mind when choosing a suitable position for the machine.

5.35 A **line bending machine** uses an enclosed infra-red element which heats plastic sheet sufficiently to enable it to be bent accurately by a pivotted bed.

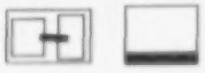
Machine sizes vary depending on the size of the plastic requiring machining.

5.36 A **hot wire cutter** works by heating a tensioned wire which melts expanded polystyrene and in turn cuts it.

5.37 It is particularly important for the

machine to be sited in a well ventilated area as fumes can be given off as the polystyrene melts. Some larger models may require local exhaust ventilation.

5.38 Some schools may provide equipment for **plastic coating** metal.



5.39 The metal is heated in an oven (which can be used for other general plastics activities) and then is placed in a fluidising bed of powder. When the plastic comes into contact with the hot metal it will fuse itself in place. These machines are available in various sizes, some units are able to sit on or alongside benching, others are considerably larger. A well ventilated room is normally adequate for this process, although some types of plastic powder require local exhaust ventilation.

Computer Numerically Controlled (CNC) Equipment

5.40 Computer controlled equipment enables a pupil to produce an item, or multiples of an item, through a fast, high precision manufacturing process. The software which runs the machine is often also a general design package, allowing pupils to design and manufacture products using the same computer.

5.41 This type of equipment may be sited in multi-materials, textiles, electronic, graphics areas or in a design resource area, suitably protected from dust. Protecting the keyboard from dust by a clear cover generally gives the computer a longer life.

CNC Machinery in Workshops

5.42 In schools the principles of computer numerical control are usually introduced through small scale equipment. In workshops the two main CNC machines are the lathe and the milling centre. Both machines are suitable for use in the workshop or electronics area, although raw materials may be more readily available in the workshops. Most machines will only work when the protective interlocked cover is placed over the machine although consideration must still be given to safe working distances. Smaller models can be easily damaged if sited where heavy duty work may be taking place.

5.43 A **computerised milling centre** can be used with a variety of materials, including easily worked materials such as plastics, brass and aluminium alloy.

5.44 Pupils create a 3D design using a computer and the milling centre cuts out the shape using different cutters. A milling machine can also create a 2D image, rather like an engraver, on sheets of composite material or plastic. The final image may be used for signs or as a template for printing.

5.45 A **CNC router** is also an efficient cutter of flat images, but it is less able to create intricate 3D shapes. A router works at a faster spindle speed than a milling machine and is therefore more suitable for working with wood and composites.

5.46 A **computerised lathe** performs the same processes as a manual lathe but at a smaller scale.

5.47 A CNC lathe can make products with repetition and greater accuracy. The tool can be moved in two axes which allows drilling as well as turning.

CNC Machinery in Textiles

5.48 **Sewing, embroidery, knitting** and **weaving** machines may all be computer controlled.

5.49 It is advantageous to position the machines near their manual counterparts as the same materials will be used in both types of machine. Most of these machines are portable. Some teachers may prefer the CNC machines to be sited near a CAD area so that the computer which runs the software for sewing machines etc. can also run other more general design packages (see Section 2, Textiles).

Miscellaneous

Printed Circuit Board (PCB) Unit

5.50 If space and budget allow, a school may wish to provide a printed circuit board unit. This has the advantage that all processes involved in producing circuit boards (develop, etch and wash) are combined within one unit. Each process has an individual tank which is inset into the unit. A PCB unit usually contains a sink with hot and cold water supply which can be used for other workshop activities requiring water. Most units require a power supply to allow for agitation.

5.51 Alternatively separate mobile tanks which sit on or into a bench can be used. Where portable tanks are used (given their considerable height) provision should be made for them to be positioned at a suitable height and with adequate protection from tipping.

Guillotine, Shears and Folders

5.52 A guillotine can cut metal sheets. Smaller models can be used by pupils. Larger guillotines should only be used by a member of staff and should ideally be situated in a preparation area, away from doorways (see Section 4, para 4.36). A bench mounted model has been developed which will cut, bend and punch small sheets of metal. Shears also cut sheet metal but are only suitable for more simple cuts. Both shears and guillotine must be lockable and positioned away from major circulation routes.

Section 6: Services and Environmental Design

The design, installation, commissioning, operation and maintenance of services must comply with statutory requirements. Note should be taken of the relevant documents listed in this section and the Bibliography. Appendix 2 gives further detail of some of the regulations mentioned in this Section.

6.1 It is advisable to produce elevations detailing the services provision on walls at an early stage in the design of a D&T space. In this way the positions of pipework, drainage, electrical trunking and heat emitters can be co-ordinated with heights and locations of window sills, furniture, fittings and equipment (see Section 4). The effect that future adaptations may have on the service installation should be borne in mind at the design stage.

Electricity

6.2 All fixed equipment should be permanently wired to the electrical distribution system and be controlled by an isolating switch located either on the equipment or within 2 metres of, and accessible to, the operator. For certain machines the switch must be lockable. Most machines also require individual emergency stop buttons, controllable via knee or foot (see Section 5). Further details can be found in BS 4163[1]. Cookers in food rooms should be wired from local isolators, although microwave and combination ovens can be connected via a 13 amp plug. All electrical equipment should be of an appropriate insulation (IP) rating.

6.3 Each work area containing fixed electrical equipment should have a lockable single switch disconnecter and an emergency stop system. These should control all the electrical power circuits except those serving equipment which is designed to remove a hazard (such as a fume cupboard). The emergency stop buttons must be readily accessible to the teacher and positioned at a height of 1.5m to ensure clearance of machines and benching. There may be several emergency stop buttons located at intervals around the room. In view of the increasing use of portable CNC machines, hand power tools and other portable equipment, it is recommended that the emergency stop system controls all socket outlets too. However, it is worth considering a separate computer circuit, to be excluded from the emergency stop system.

6.4 The need for additional protection should always be considered. For example, Residual Current Devices (RCD's) cut off the power supply to the room in the case of a fault in the circuit. Any equipment designed to remove a hazard should not be included on these circuits. Where electrical experiments are being carried out a higher standard of protection can be achieved by the use of 1:1 Isolating Transformers[2].

6.5 Electric arc welding equipment must have a properly earthed transformer. A separate earth lead from the workpiece to the mains earth should be fitted[3].

6.6 Extra low voltage for practical work can be provided either by portable transformers providing a range of voltage or by bench mounted trunking systems (see Section 4). Electrical systems in furniture have particular requirements regarding the number of socket outlets, connected loads, fuse protection, shock protection, earthing etc[3].

6.7 Where portable equipment is provided, details of potential benching layouts together with the electrical loading of each supply point must be assessed during the early stages of the development to ensure the potential loading of circuits is fully considered. Only portable equipment rated at less than 13 amps should be fitted with a normal BS 1363[4] plug top. If equipment is used outside the building via a flexible cable a residual current device (RCD) should be fitted to the supply.

Gas

6.8 The principal isolating gas tap to each space should be easily accessible. Advice on gas installations is given in publication IM/25[5].

6.9 When not in use, oxygen and acetylene cylinders directly connected to a welding bench must be stored in an area agreed with the fire officer. If the gases are piped to the bench, from an external store, this must be of fire resistant con-

Notes
[1] BS 4163: Health and Safety in workshops and other establishments 1984: BSI
[2] Electrical Safety in Schools. GS23. HSC.
[3] BS 6396: BSI
[4] BS 1363: BSI
[5] IM/25: Guidance Notes on Gas safety in Educational Establishments: DFE

struction with access from the outside only. Gas bottles must always be housed in a well ventilated area, whether in use or not.

6.10 Cylinders of liquid petroleum gas (sometimes used for brazing) must be kept in a ground level fireproof store. This must be separate from oxygen cylinders and any combustible materials. It is essential to follow all safety precautions when using bottled gases and the fire prevention officer must be consulted at an early stage. Refer also to BS 4163[3].

Compressed Air Supplies

6.11 Compressed air can be supplied locally by a portable unit with flexible pipework or it can be piped from a fixed remote unit. The main dangers from using compressed air [4 and 7] are:

- An airline being directed at a part of the body
- Excessive working pressures.
- Air receivers installed in cramped, inaccessible and poorly ventilated areas.
- Home made air (or steam) receivers or those which have not had regular inspections: these can explode at high pressure.

6.12 All compressors should be kept out of the reach of pupils. Where mobile compressors of up to 50 litres capacity are used, compliance with manufacturers' recommendations on maintenance and testing are essential. This will involve weekly checks of oil level, periodic draining of the condensation water from the receiver, and an annual check of the inlet and outlet filters. For larger mobile compressors or fixed systems there are more stringent procedures to adhere to, as described in SI 1989/2169[4].

Water

6.13 Hot and cold water should be provided in workshop, food and textiles areas. There should be drinking water in food rooms. Sinks should be fitted with bottle traps and wherever weak solutions of acid are used, wastepipes should be able to withstand the corrosive effect.

Environmental Design

6.14 Environmental standards including heating, ventilation, lighting and acoustics are covered in the DFEE publications listed in the bibliography. The following summarises the main requirements.

Ventilation and Heating

6.15 Ventilation should be achieved by natural means wherever possible. Any ventilation and extraction systems should be designed by specialists to create appropriate conditions for comfort and health.

6.16 Mechanical extract ventilation may be required in food areas and heat bays. Rooms with high electrical loads may need mechanical ventilation due to the heat build up. It may also be required in internal rooms and for fume and dust extraction. Untimetabled resource areas are often internal spaces for which the ventilation requirements should be carefully considered.

6.17 An appropriate temperature must be maintained at all times in workshops and in preparation and storeroom areas. Low temperatures and draughts may make it more difficult to handle materials[8] or operate machinery. High temperatures and inadequate ventilation may lead to fatigue and damage to timber stocks.

6.18 Food stores, refrigerators and freezers must be maintained at the correct temperature[9]. If refrigerators or freezers are kept in store rooms there must be sufficient ventilation so that the general conditions remain cool.

Fume and Dust Extract

6.19 Under the COSHH[10] regulations it is the responsibility of the employer to ensure that all potentially hazardous substances and processes are assessed. It is also the employer's responsibility to ensure that measures are taken to limit the concentrations of these substances and the length of time that people are exposed to them.

6.20 Some hazards can be dealt with by having a good level of background ventilation, e.g. by opening windows, but others will require 'at source' extraction. A spray

Notes
[4] SI 1989/2169 Pressure Systems and Transportable GasContainers Regulations
[7] Compressed Air Safety 1990: HSE
[8] Manual Handling operations Regulations 1993: HSE
[9] Food Safety Act 1990
[10] COSHH: Control of substances Hazardous to Health 1989: HSC

booth with exhaust or water backed ventilation should be used when spraying large amounts of paint. Benches where solvents, e.g. glues, are in use may require extraction depending on the extent of use and the type of solvent. Risk assessments are available for most substances and processes occurring in schools[11].

6.21 Fume extraction will be required in any heat treatment area used for welding, brazing forging etc[1]. Fume cupboards should be used for acid etching.

6.22 Dust extraction will be necessary from woodworking machines[1]. As fine wood dust must be kept separate from wood flakes because of the danger of explosion, machines such as the linisher should have their own separate extraction system. For all other machines, it may be worth locating them in such a way that allows for a shared common extraction system. Dust collection units should be earthed to prevent the risk of explosion. An inlet should be placed at floor level to facilitate sweeping up in the preparation area. Wood, plastic and metal dust and particles should not be collected in the same extraction system due to the risk of explosion. Specialist advice should be sought in this area.

6.23 When designing a heating system, it should be borne in mind that heat emitters should not circulate dust. The position of emitters should be carefully coordinated with the furniture and equipment layout. Food rooms should ideally be enclosed in order to prevent dust from contaminating food. This is particularly important if there are multi material workshops nearby.

Lighting

6.24 The quality of light is very important for safety reasons and to contribute to the general atmosphere of a teaching space. Much can be achieved through the design of the building form, selection of light fittings and use of colour. Ideally, all teaching spaces should be lit by natural light, supplemented in deep rooms by electric light. Dim-out or black-out is required when visual aids are to be used.

6.25 DN 17[12] recommends a level of 300 lux for general lighting in most teaching areas and 500 lux wherever visually demanding tasks, such as fine work with fabric, are done.

Additional task lighting needs to be considered for machines in the multi-material space and possibly for other activities such as circuit board work. Directional lighting enlivens display areas. If a lit display unit is enclosed, it will need to be designed to avoid the build up of heat as this can be a fire hazard.

6.26 Subdued lighting should be provided for brazing and forging work areas as direct light might prevent a lit torch being seen. The walls in heat treatment areas should be matt to avoid glare from reflections. This also applies to rooms with a high level of visual display equipment.

6.27 In storage and preparation areas lighting levels should be adequate for staff to see loads clearly and assess their weight before handling. Electric lighting should provide an even spread of light without deep shadows in order to minimise tripping hazards[8].

6.28 The choice of light fitting is particularly important in workshop areas. Machine lighting should be fitted with deep reflectors to avoid glare from shiny surfaces. In certain circumstances some electric lamps, particularly fluorescent, can create a stroboscopic effect, making moving parts of machinery appear static. This can be overcome in various ways including using high frequency control gear. Refer to BS 4163[3].

6.29 Emergency lighting is required for machine areas in order to provide illumination where machine parts may continue to move after the electricity supply has failed[13].

Acoustics

6.30 While open plan areas can be attractive, it is important to design a comfortable acoustic environment. Consideration must be given to the level of noise created by certain machines such as the planer and large dust extraction units. Where possible, steps should be taken to reduce noise generation at source. DN 17[12] and BS 8233[14] give suitable levels of background noise and sound reduction between rooms. In order to achieve these levels it may be necessary to limit open plan areas to the quieter activities. Acoustically absorbent material can be used to reduce the amount of reflected sound (i.e. reverberation time).

Notes
[11] Risk Assessments for Technology in Secondary schools 1990: CLEAPSS.
[12] Design Note 17: DES.
[13] BS 5266: Emergency Lighting.
[14] BS8233: Code of Practice for sound insulation and noise reduction for buildings 1990; Section 9: Educational Buildings.

Section 7: Case Studies

This section shows the guidance given in sections 1 to 6 applied to real design and technology departments. There are seven case studies. The first five are design exercises using existing schools that reflect typical situations. The last two are actual building projects; one adaptation and one new building.

7.1 The schools vary in type and size, from a 260 place middle school to a 1250 place comprehensive. Different balances of specialist spaces and varying room layouts reflect contrasting approaches to teaching design and technology. Existing school buildings may have spaces that are less than ideal. These case studies show ways of making the most of such situations.

7.2 The design exercises show spaces refurnished and re-equipped following the principles described in Section 2. The maximum group size is assumed to be 21[1]. The furniture and equipment layouts in the building projects (Case studies 6 & 7) have been planned by the schools and their consultants to suit the needs of the individual school. In the adaptation example (Case Study 6) much existing furniture and equipment has been re-used, reducing the overall cost of the project.

7.3 An analysis of all the adaptation case studies is shown in Table 7/1, after Case Study 6. Cost breakdowns of Case Studies 2 and 3 are provided in Section 8.

Note
[1] Except in the middle school example.

Case Study 1: A Middle School (Design Exercise)

As Existing (Fig. 7/1)

7.4 Case study 1 is a 9 to 13 middle school with 260 pupils on roll. The school was built in 1971 using a frame system. A workshop, food room, art room and general teaching room are housed in a detached block which is linked to the rest of the school by covered walkways. A cloakroom area and a wide corridor are used for certain activities but this is not considered satisfactory by the school.

7.5 All three practical spaces are small, in particular the food room which is only 35m². The school can afford to 'lose' the general teaching room and the toilets but otherwise the adaptation is limited to the area available in the block. Storage is limited and the provision of equipment is poor, particularly for the preparation of materials.

7.6 Middle schools may find it difficult to provide a full range of technology and art facilities because the numbers on roll may only warrant a few practical teaching spaces. There is likely to be an overlapping of facilities.

Proposed Adaptation (Fig. 7/2)

7.7 The curriculum and timetabling organisation of this school suggests that three spaces for groups of 15 are shared between art and design and technology. The existing workshop, art room and general teaching room are enlarged and the latter is converted into a food/textiles space. A route through the building is retained but reduced in width.

7.8 The adaptation is restricted by the area of the existing building. This means that all the spaces are a little small for the wide range of activities taking place in them. The amount of storage space is increased but remains less than ideal and the range of furniture and equipment is limited. The main features of the proposal are described here.

Figure 7/1
Case Study 1 as existing

- The multi-materials workshop is enlarged and a brazing hearth, flanked by low walls, replaces the kiln. Pedestal mounted machines are kept to a minimum but bench mounted machines provide additional opportunities for working with construction materials. There is a short run of fitted electronics benching and a position for a computer trolley.
- There is insufficient area for a preparation/storage room but a handbasin in the main space provides the teacher/technician with some facility for preparing construction materials. It is possible to lock the handbasin when not in use (see Section 5).
- The enlarged art room is equipped to cater for a wide range of art activities including ceramics, wet textiles and drawing.
- Surplus toilets are removed in order to create the food/textiles space. As is often the case in middle schools the food and dry textiles activities share a space. The textiles facilities are kept to one end of the room away from the main cooking area but the success of this combined space depends also on the way in which teachers manage the space and organise activities. Because of the age of the pupils the cooking facilities are limited to domestic units only and there is minimal equipment shown for food and textile 'technology'. This room is enclosed for hygiene reasons.
- As there is insufficient area to keep coats and bags in the teaching spaces, they are stored in the two lobbies at each end of the suite.
- A small resource bay houses computers and display of pupils' work. In a small suite such as this, the three spaces are likely to share the facility.

Figure 7/2
Case Study 1 as proposed

Case Study 2: A Small School (Design Exercise)

As Existing (Fig. 7/3)

7.9 Case Study 2 is an 11 to 16 comprehensive school with 600 pupils on roll. The existing accommodation consists of four design and technology spaces and two art spaces in a semi open plan ground floor suite, surrounding a small drawing area. The science department is adjacent to the design and technology suite.

7.10 The relationship between the areas is good, allowing sharing of resources and equipment between specialist spaces. However, some spaces are rather small and the storage is insufficient, particularly in the food and textiles areas.

Proposed Adaptation (Fig. 7/4)

7.11 The existing number and balance of timetabled spaces is appropriate for the school's curriculum. Therefore, the four existing design and technology spaces retain their functions. The support spaces are slightly modified to provide extra storage and a more useful central area. The main features of the adaptation are outlined below.

- Each multi-materials space has 16 vice positions at workbenches with additional positions on side benching. There are no design tables in the workshops themselves but the enlarged central design area provides a useful supplementary space.
- Both workshops have electronics facilities but the main provision for electronics and other control activities is in Multi materials 2. The overall size of this space is similar to the example shown in Section 2 but serviced tables replace some of the side benching.
- The textiles space provides facilities for both 'wet' and 'dry' activities, zoned into two distinct areas. Although the floor area is less than that suggested in Section 2, the open planning allows easy access to the supporting design area. The 'wet' area is located for easy access from the adjacent art room.
- The wall between two materials stores is removed to form a combined preparation and storage area.
- Overall storage remains less than ideal but is significantly increased, especially for food and textiles (see Table 7/1).
- The 'dining/seminar' area adjacent to the food room is enclosed to form a staff base and seminar room.

Figure 7/3
Case Study 2 as existing

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Figure 7.4
Case Study 2 as proposed

Case Study 3: A School Without Workshops (Design Exercise)

As Existing (Fig.7/5)

7.12 Case Study 3 is an 11 to 18 school with 660 11 to 16 year old pupils and 220 sixth formers on roll. The existing first floor accommodation provides three design and technology spaces, two food rooms and one textiles (both wet and dry). There are two art rooms alongside. Science laboratories are on the ground floor.

7.13 The food rooms are of a reasonable size but the textiles space is undersized for the wide and varied range of activities taking place. There are no facilities for multi material work or electronics. Much of the furniture is inappropriate and in poor condition. There is a large general teaching room on the first floor which can be adapted.

Figure 7/5
Case Study 3 as existing

Proposed adaptation (Fig.7/6)

7.14 The curricular organisation of this school suggests four spaces with the following specialisms: multi materials, control technology, food and textiles. A new multi materials workshop is added on the ground floor with associated preparation and storage space and a small room for sixth form science project work. The first floor is adapted to provide an electronics/control room and the textiles room is enlarged to better accommodate both wet and dry activities. Support areas include an uninterrupted design and resource area and a staff base. The main features of the proposal are described below.

- As only one room is allocated to multi materials, the provision of pedestal mounted equipment is less than ideal for a school of this size. Limitations on space allow only one item of heat treatment equipment (a combined brazing hearth and chip forge). However, a full provision of multi benches, plastic working equipment and drawing tables make it possible to perform a variety of activities using a reasonable range of construction materials.
- The location of the workshop on the ground floor is convenient for materials delivery and avoids any problems caused by the additional structural load of heavy machinery. Links can be established with science and the outside space can be used for large scale projects. The staircase which links the workshop with the rest of the department is easily accessed.
- There are enough serviced tables in the electronics/control room to enable a whole class to do electronics or pneumatics activities at the same time, reflecting the curricular emphasis of the school. Toolbox for resources and plastics equipment supplement those in the multi materials room on the ground floor. Raw materials for making can be kept in the adjacent room.
- The textiles room is larger than that illustrated in Section 2 because it accommodates a wide range of activities including screen printing. In this school textiles is taught primarily through design and technology but the room location allows

facilities to be shared with the art department. The storage area for this room is increased.

- The design resource area houses computers, drawing tables and a sink and can be shared between design and technology and art. It can also serve as a project area for sixth formers in either department. It is located to allow easy access from the stairs. New internal glazing allows visual supervision from the textiles area and staff base. The latter can be shared between design and technology and art.

Figure 7.6
Case Study 1 as proposed

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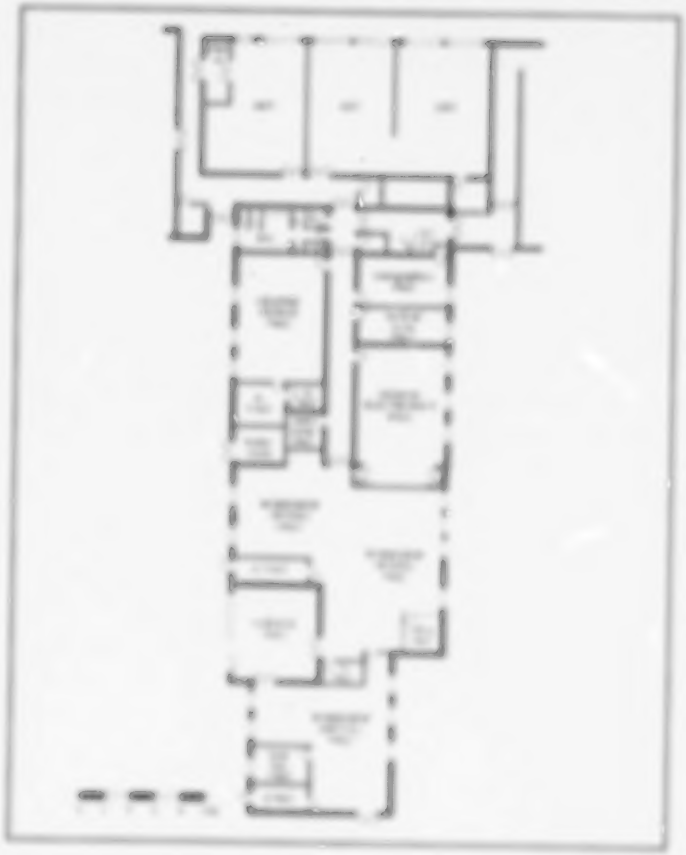
Case Study 4: A School With Traditional Workshops (Design exercise)

As Existing (Fig. 7/7)

7.15 Case study 4 is an 11-18 comprehensive school with 750 11 to 16 year old pupils and 100 sixth formers on roll. The existing teaching accommodation comprises five design and technology spaces: one metalwork, two woodwork, one electronics and one graphics. There is also a garage which is no longer used. These are spaces are located in the same part of the school.

7.16 The size of the teaching spaces is generally adequate, with the exception of the smallest workshop. There is insufficient storage and no separate preparation area. The workshops are once provided with out of date equipment.

Figure 7/7
Case Study 4 as existing



Proposed Adaptation (Fig. 7/8)

7.17 The design and technology curriculum of the school suggests retaining the five spaces but changing the balance of specialisms, in order to broaden the range of pupils' experiences. The proposal is for three multi-materials workshops, an electronics/control room and a textiles area. These are supplemented by a resource base, adapted from relocated rooms. The garage is converted into a preparation room, allowing some of the smaller stores to be removed. The main features of the proposals are outlined below:

- Multi-materials 1 retains its metal emphasis and Multi-materials 2 has more wood based machinery but both spaces provide for a full range of construction activities. The removal of a small store improves the link between these two areas and a new door provides a link with the electronics/control space.
- In Multi-materials 3, the heat treatment area and store rooms are relocated in order to provide a better shaped space, which is more flexible and more easily supervised.
- The third workshop, which is too small to accommodate a full range of large pedestal machinery, is equipped for small scale making activities using bench-mounted machines and equipment. It can be used for lessons in graphics skills for whole class groups, using a variety of table surfaces. It may be used in conjunction with the adjacent space in a team teaching arrangement.
- The new preparation and storage area is well located to serve the three workshops. A store room is added to the electronics/control room. Overall storage areas are still less than ideal but are increased by over 50%.
- The existing graphics room is converted into a textiles room, expanding the range of materials available. Resources may be shared with the nearby art department.
- The centralised resource area provides a facility for the units which can also be booked by others. Pupils can make use of books, disks and nine computers for investigation, design and graphic work. Sixth formers can work here in their study time. A glazed opening allows supervision from the adjacent space.

Figure 7.6
Case Study 4 as proposed

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Case Study 5: A Large Department (Design Exercise)

As Existing (Fig. 7/9)

7.18 Case Study 5 is an 11 to 16 technology college with 1250 pupils on roll. A proposal has been agreed to increase the numbers to 1350. The design and technology department which is all in one block comprises: four multi-material spaces (one with a metal emphasis, one wood, and one combined with electronics), a food room and two textiles rooms. There is also a small CNC machine space and a central preparation room. An adjacent IT room is available to be brought into the adaptation.

7.19 The size of the teaching spaces is generally adequate with the exception of the smaller textiles room at 64m². However, the links between spaces are poor with the two textiles rooms at opposite ends of the suite and one multi-materials room far from the preparation room. The total area of store rooms is adequate but they are badly positioned with small stores often cutting into the corner of a teaching space and an internal preparation room making material deliveries awkward.

Figure 7/9
Case Study 5 as existing

Proposed Adaptation (Fig. 7/10)

7.20 The increased numbers and the schools curriculum and timetabling suggest the need for one more teaching space and a change in the balance of specialist areas. The relocated IT room provides the extra space. The suite is reorganised to provide a more appropriate balance of specialist areas and to improve links between spaces. The main features of the adaptation are listed below.

- The relationship between specialist spaces is improved by grouping the two textiles rooms together at one end of the suite and all the workshops at the opposite end.
- The main circulation route is more direct and widens out at the entrance to the suite forming a display area. The existing CNC room is opened up to provide an untimetabled design area to be used by all D&T pupils. Partly glazed partitions enable teachers to supervise the area.
- The shape of Multi-materials 2 is improved. A store in Multi-materials 1 is converted into a separate heat treatment area.
- Multi-materials 3 is equipped with bench mounted machinery for small scale construction work and serviced tables for electronics and control technology. There is sufficient table space for a whole class to have a graphics skills lesson.
- The preparation room which is relocated to allow for external access, has direct links to two workshops.
- The electronics/control room has enough serviced tables for a whole class to do electronic or pneumatic work simultaneously. There are also facilities for modelling and for CAD/CAM.
- The existing food room is enlarged and a second food room is added. An office is converted into a separate food tasting area. As it is located close to the room entrance it can be used by either food space.
- In the smaller textiles room the removal of a store creates a larger and more regularly shaped space. As both textiles spaces are rather small, the tables are smaller than recommended at 1200mm x 600mm. The resource area between the two rooms is used for computer tables and storage.

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Figure 7/10
Case Study 5 as proposed

Case Study 6: A School with Multi Purpose Workshops (Building Project)

Background

7.21 Case study 6 is an 11 to 18 school with 660 11 to 16 pupils and 100 sixth formers on roll. The school, built in the 1930s, has had a history of technology teaching and was a Technical School in the 1970s. For this reason it had a good provision of traditional workshops all in the same block.

7.22 TSI funding in the early 1990s enabled the school to create an additional workshop by converting a store room into a food room. The funding also enabled the internal remodelling of the traditional workshops into more multi-purpose areas which suited the school's teaching approach. Further funding will enable a second workshop to be built in a separate block (not illustrated here). This additional work, resulting in a total of seven spaces reflects the high percentage of technology taught, an average of 12 % for years 7 to11. Maximum group sizes at KS3 and KS4 are 22.

7.23 The school has chosen to include business studies as part of its design and technology course throughout KS3 and KS4. IT is fully integrated into each project and the school is hoping to develop the IT aspect of control technology more fully in the near future. Manufacturing and Business GNVQ, which are offered at post-16 level, are taught in the technology block.

Figure 7/11
Case Study 6 before adaptation

The Adaptation (Fig. 7/12)

7.24 With the exception of food, all aspects of design and technology are taught in every workshop. In each area pupils are able to carry out projects in a wide range of materials (including textiles) as well as design and evaluate their products. Each space has a 'clean' area with flat top tables and supporting IT. The suite has the following features:

- All workshops are divided into two areas, one for making activities, and another for design and evaluation activities. There is, however, no physical separation and there is often a crossover between the two.
- Multi-materials 5 provides the main facility for control technology with eight centrally serviced tables offering a specific timetabled resource. However, the room is usually used as a multi-purpose workshop.
- Compressed air and low voltage outlets are supplied throughout the suite in a series of trunking lengths. This enables pupils to carry out work with various control systems.
- All workshops have a reasonable range of freestanding and bench mounted machinery, including facilities for plastics. Each workshop has one item of heat treatment equipment although casting facilities are provided in a specific heat treatment room.
- Five multi-purpose benches with vices are provided in each workshop.
- Standing height work surfaces are fixed to the wall. A series of loose tables provide sitting height surfaces at the perimeter for sewing machine and computer work. This increases the potential for reorganising the layout of the space in the future.
- Each workshop has enough flat top tables for a maximum group size of 22 pupils. This provides facilities for design and evaluation exercises, including modelling work, as well as more formal lessons with the teacher using an OHP or TV and video.

- Storage furniture in the rooms supplements facilities in the two preparation areas which are small for a suite of this size. This allows easy access by pupils to a range of resources and suits the school's philosophy towards the use of general design and technology rooms but it does result in some duplication of resources which can be expensive.
- Due to the restrictions of the existing building, the food room is small and an awkward shape. However, it does provide the pupils with opportunities for designing and making through food. The space is divided into two zones. A small design area, with IT provision, allows pupils to design and research whilst other pupils are preparing their food in the kitchen area.
- Fixed octagonal units create cooking bays in the food room. This is an alternative arrangement which is generally less flexible than the combination of fixed perimeter work surfaces and loose tables illustrated in Section 2. However, in such a long narrow space it is an effective way of providing pupils with adequate serviced work surface

Figure 7/12
Case Study 6 as adapted

Summary of Adaptations

7.25 Table 7/1 summarises the changes in the six adaptation case studies. A notional model, based on the guidance in Sections 1 to 3, is shown for comparison. The following factors have been taken into account in calculating the models, reflecting the differences between the individual schools:

- size of department
- the age range of the pupils
- the range of specialist activities taking place in one space.

Wherever space is limited, priority is given to timetabled teaching area.

7.26 Where art rooms are shown on the plans, these have not been included in the table.

7.27 These case studies show that considerable improvements can be made to existing accommodation, often with minimal alterations. In all cases except for one, the timetabled teaching area per pupil is increased and in most instances the storage area has also increased.

Table 7/1
Analysis of Case Studies 1 to 6

Key
E= Existing
A= Adapted
N= Notional
PP= Pupil place(s)
TA= Teaching area
SA= Storage area

	CASE STUDY 1			CASE STUDY 2			CASE STUDY 3			CASE STUDY 4			CASE STUDY 5			CASE STUDY 6		
	E	A	N	E	A	N	E	A	N	E	A	N	E	A	N	E	A	N
No. of timetabled spaces	2	2	2	4	4	4	3	4	4	3	5	5	7	8	8	6	6	6
No. of PP	15	30	30	84	84	84	63	84	84	105	105	105	147	168	168	132	132	132
Timetabled TA (m2)	83	163	160	361	365	407	270	370	392	442	663	477	616	711	753	582	668	668
Untimetabled TA (m2)	15	15	15	50	40	42	13	70	60	9	50	63	50	50	61	0	0	84
Prep/SA (m2)	10	17	32	48	64	76	23	60	80	49	76	87	110	72	176	131	69	107
Timetabled TA per PP (m2)	5.53	5.77	5.33	4.30	4.35	4.85	4.29	4.40	4.67	4.21	6.22	4.54	4.19	4.23	4.48	4.41	5.06	5.07
Prep/SA per PP (m2)	0.67	0.55	1.05	0.58	0.76	0.91	0.37	0.80	0.95	0.46	0.72	0.83	0.75	0.43	0.69	0.99	0.52	0.81
Total area per PP (m2) (excluding circulation)	7.20	5.65	6.68	5.47	5.56	6.23	4.67	6.16	6.33	4.75	5.50	5.97	5.29	5.01	5.66	5.40	5.58	6.31

Case Study 7: A New Suite (Building Project)

Background

7.28 Case study 7 is an 11 to 18 Comprehensive school with 540 11 to 16 pupils and 200 sixth formers on roll. The sixth form is combined with a neighbouring school who also send some of their Year 7 and 8 pupils to use the design and technology facilities. A new design and technology and art block was built in 1991. Until that time the school had very limited design and technology facilities and inadequate art accommodation.

7.29 The school, which is a Technology College, teaches a high percentage of design and technology at both Key Stages 3 and 4. It also offers some GNVQ courses at Post 16 level and intends to increase the range of courses in the near future. The curriculum and the timetabling arrangements require a total of seven design and technology spaces, allowing for pupils from the nearby school to use the facilities. Maximum group sizes are 21. At KS3 and KS4 design and technology is taught through discrete schemes of work in each specialist space but, helped by the suiting of the accommodation, there is a significant amount of team work between teachers.

7.30 The business studies room is booked at certain times of the week as a resource for design and technology. Individual pupils at KS4 consult the business studies teacher if their particular project requires it.

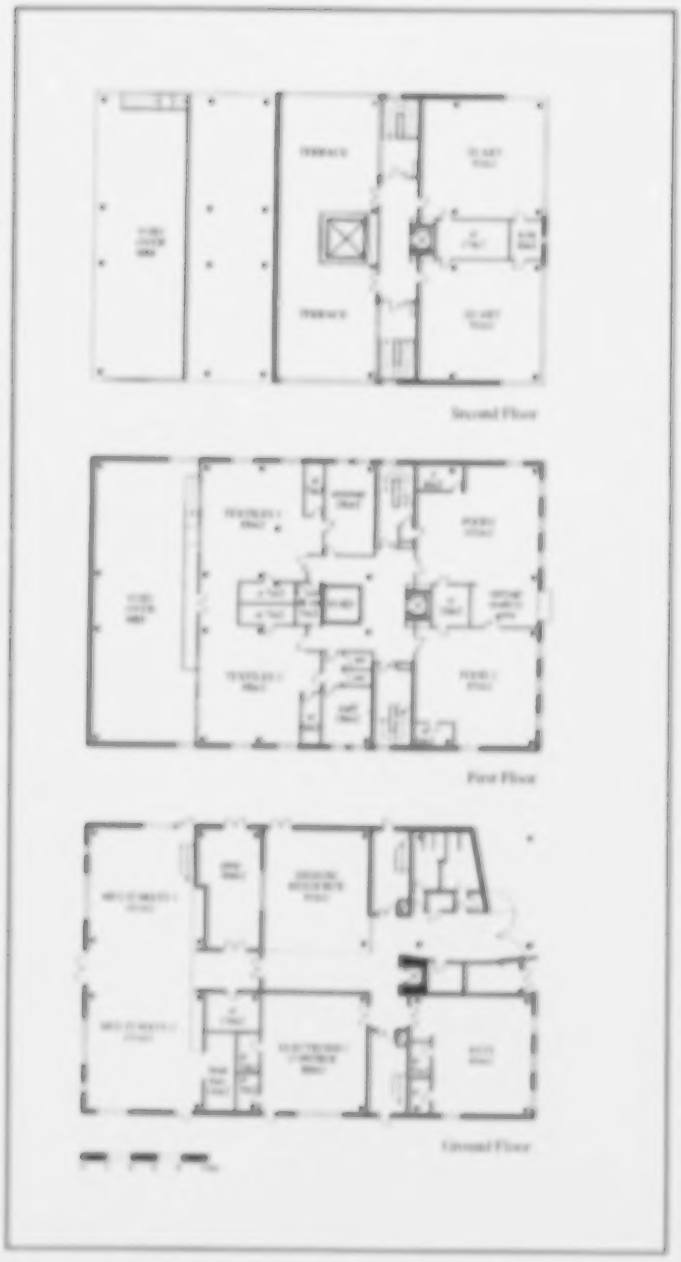

Figure 7/13
Ground, first and second floor plans of new building

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The New Building (Fig. 7/13)

7.31 The suite is a three storey purpose built block housing design and technology on the lower two floors and art on the third floor. The block has a bright open feel with light wells in the circulation areas and obvious links between pairs of spaces such as the two multi materials areas. The suite has the following features:

- The workshops are attractive and airy spaces although their open plan nature does cause some acoustic problems. Pupils design and make with a wide range of materials, using pedestal machinery complemented by CNC and bench mounted machinery.
- The Electronics/Control room enables pupils to experience a variety of control activities which may be taught individually or to a whole class group at one time. The activities include circuit board work and mechanical work as well as making three dimensional models in a variety of materials.
- Food 2 provides a run of commercial catering units alongside domestic catering. In Food 1, a domestic catering provision is supplemented by a food technology bay. The two rooms share a small resource area where pupils can access information and carry out tasting evaluations.

Figure 7/14
Ground Floor furnished

- Both textiles rooms are used by the design and technology department although Textiles 1 is also used occasionally by the art department. There is little distinction between the two rooms in terms of activities or accommodation, although more printed textiles activities take place in Textiles 1 which has a large printing table.
- In this school business studies has a very clear role within design and technology, hence the business studies room in the suite. Clusters of IT equipment are interspersed with desks and chairs for written and group activities.
- The resource area is timetabled for 50% of the week for specific whole class graphics activities particularly for the post 16 pupils. For the remaining time it is used by pupils individually as a resource for their design work.

Figure 7.15
First Floor furnished

Section 8: Cost Guidance

This section gives guidance on the capital cost of providing and fitting out design and technology accommodation in secondary schools. It is divided into three parts: 'General Cost Matters', 'Furniture and Equipment' and 'Case Study Cost Analyses' relating to the Case Studies illustrated in Section 7.

General Cost Matters

Building consultants' fees

8.1 New building work, including conversions and substantial adaptations to existing accommodation, will normally be managed and supervised by professional building consultants. Depending on the nature of the work, this service will usually cost between 10% to 15% of the value of the building contract, although higher fees may be payable in exceptional circumstances. The fee will cover the cost of employing – where appropriate – architects, engineers and surveyors. Whenever possible, a number of consultants should be considered for each specialism. The respective professional institutions will supply details of the services that can be provided as well as information on fees.

8.2 The value of the building contract on which a fee is assessed will usually include for fixed furniture and fittings, e.g. shelving, benching and cupboards. Care should be taken to ensure that fees are not paid on the value of items which, while forming part of the main building contract, have been independently designed, procured and fixed by a specialist contractor. This is because the cost of providing these services will have been included within the price for the work. There may, however, be fees payable for any necessary co-ordination and liaison work between the project team and specialist contractors.

Value Added Tax

8.3 Under current regulations most school building work will attract VAT at the standard rate. The exception is in the case of free-standing buildings and some types of extension project at schools which have charitable status, i.e. most voluntary aided, and grant maintained schools. In these cases the work is zero rated. Furniture and equipment and professional fees are standard rated whatever the type of project. DFEE grant aid will cover the additional burden of VAT where payable. In LEA school building projects any VAT payable is recoverable by the local authority.

8.4 As VAT can have a considerable impact on the cost of a project, advice on its application should be sought from the local HM Customs and Excise Office at an early stage in the planning and design process.

Project phasing

8.5 When it is necessary to consider phasing building work over a period of time, the diseconomies associated with carrying out a number of small building projects instead of a single large one will need to be allowed for when the initial budget is set. Funding for phased educational projects is usually contingent upon each phase providing accommodation that will be fully operational in the event of further funds not becoming available.

New building versus adaptation/ refurbishment

8.6 Constructing and fitting out a completely new design and technology building can cost between £900 and £1,100* per m² of gross floor area provided. These costs include for building work, furniture, equipment, site works and professional fees, but exclude land purchase costs and VAT. Factors influencing the cost include briefing requirements, standard of specification, site conditions and ease of access, the size of the project, and whether the building is single or multi-storey.

8.7 The costs of adapting and refurbishing existing buildings tend to be more variable. They depend on the degree to which the existing structure and services need to be altered and on the amount of existing furniture and equipment that is re-used. In the case of refurbishment requiring, for instance, only redecoration and a few extra

Note

* All costs given are at second quarter 1995 national average prices and may be updated to current price levels using appropriate tender price indices available from the Indices Group of the Department of the Environment.

service outlets and where there is substantial re-use of existing furniture and equipment, the costs may be less than 10% of the cost of new. In larger projects involving extensive structural remodelling and renewal of services and where new furniture and equipment is provided, the costs can approach those of a new building.

8.8 However, where there is a choice between building new and adapting or refurbishing existing accommodation, the latter will usually provide a more economic solution as the capital costs are likely to be lower. Also, as the amount of area in use does not increase, the recurrent costs associated with new space, e.g. heating, lighting, cleaning, maintenance, rates etc., will be avoided. These can cost up to £40 per m² of gross floor area annually. In addition, the adaptation or refurbishment of an existing building may make it easier to create or maintain appropriate links between existing curriculum areas.

8.9 All projects, whether for new building, adaptation or refurbishment, should be considered in the context of a school's overall long term building development plan.

Temporary accommodation costs

8.10 Outright purchase and installation of temporary buildings fully fitted with design and technology furniture and equipment can cost between £450 and £600 per m² (excluding VAT). This is about 50% to 75% of the cost of equivalent new permanent accommodation. Although cheaper than permanent accommodation, temporary buildings generally have a shorter life expectancy. They may also be less convenient if they are isolated from the rest of the design and technology department, making the sharing of resources and equipment more difficult. They can, however, provide a cost effective solution to a short term accommodation need, e.g. during building work, or to accommodate a short term peak in a school's roll. A typical six month hire charge for a 100 m² temporary building fully fitted and serviced for design and technology, inclusive of delivery, installation and removal, is between £14,000 and £17,000 (excluding VAT).

Furniture and Equipment (F&E)

8.11 In some Local Education Authorities the procurement of furniture and equipment, sometimes both fixed and loose, is managed by the authority's supplies organisation. As an authority wide service its cost may not always be attributed directly to individual projects. It will, however, need to be taken into account in projects at grant maintained and other schools which do not automatically receive support from an LEA supplies organisation. In these cases it may be necessary to employ the project architect or another agency to provide the procurement service. This can cost up to 6% of the value of the furniture and equipment supplied. In smaller projects this work is sometimes undertaken by the school itself.

8.12 Owing to the wider range of F&E available for design and technology compared with, say science, fewer companies are able to provide a complete 'turn key' service in fitting out design and technology accommodation. Those that do often buy in many of the items from other suppliers. Although some companies claim they can provide all the F&E for a project, this can sometimes result in the school receiving the company's standard stock items which may not always be appropriate to the particular needs of the design and technology department.

8.13 With some items of equipment, e.g. lathes, schools sometimes deal directly with the manufacturer. Some machinery can be purchased second hand at specialist dealers and at auctions, although allowance will need to be made for the cost of any overhauling and safety checks. The Health and Safety implications of re-use will need to be considered as older furniture and equipment may no longer meet with current standards (See Appendix 2).

Figure 8/1
Case Study 1

Case Study Cost Analyses

8.14 Figures 8/1 and 8/2 illustrate two of the case study adaptations (3 and 4) which are described in Section 7. Tables 8/1 and 8/2 provide model cost analyses based on typical budget prices, excluding VAT, of the building work and furniture and equipment provision for these case studies. The left hand boxes show the overall capital costs attributed to each of the main elements together with building costs per m². The furniture and equipment costs, which are taken from the layouts shown in Figures 7/6 and 7/8, are analysed on a room by room basis in the right hand box. The adjacent pie charts show the percentage distribution of costs.

Building costs

8.15 Adaptation costs include: demolition, closing up and forming openings, new internal walls, doors and windows, new and upgraded mechanical and electrical services installations, new floor and ceiling finishes where necessary, full internal redecoration in areas affected by building work and modification of external drainage and service runs. No allowance is made for the cost of making good any existing building defects, or for work beyond the area shown on the plan.

Furniture and equipment costs

8.16 The costs in Tables 8/1 and 8/2 allow for entirely new furniture and equipment. The costs include items such as shelving, filing cabinets, tables, and overhead projectors. Procurement and installation costs are also included. In most adaptations and conversion projects, however, it is likely that there will be scope for re-use of existing items. It may be possible, therefore, to achieve the kind of solutions shown here at a lower cost.

Figure 8/2
Case Study 4

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Overall cost analysis

	Cost £	Cost £/m2
New ground floor extension (150m2 total area)		
Substructure	12,710	79
Superstructure	70,850	436
Internal finishings	5,125	32
Mechanical and electrical services	14,280	88
External works	7,125	44
Sub-total (a)	110,000	678
Alterations to existing building (280m2 total area)		
Structural changes to walls, door openings etc	29,256	87
Internal finishings	27,148	81
Mechanical and electrical services	14,809	37
External works		
Sub-total (b)	87,713	316
Building Works Total (sub-totals a+b above)	177,713	
Professional fees @ 15%	26,657	
Fixed furniture (from line opposite)	12,676	
Loose furniture (from line opposite)	27,254	
Equipment (from line opposite)	80,000	
ESTIMATED TOTAL PROJECT COST	£ 443,300	

Furniture and equipment costs

	Fixed Furniture £	Loose furniture £	Equipment £
Room			
Multimaterials	1,431	3,837	20,000
Electronics	1,176	10,676	20,140
Food	6,910	2,983	15,038
Textiles	1,825	4,264	8,388
Design/Resource	834	3,765	5,674
Prep. room	212	952	10,441
Store rooms	2,095	1,885	
Staff	193	892	1,252
Totals	12,676	27,254	80,933

Note
Costs at Q2 1999 prices, VAT excluded

Table 6.1
Case Study 3: Cost breakdown and distribution of costs

Cost Comment

6.17 Both cost analyses highlight the significance of furniture and equipment costs as a proportion of the overall budget. The pie charts show that in Case Study 3, involving a mix of new building and adaptation work, furniture and equipment accounts for nearly 40% of the overall cost, of which about two thirds is for equipment. Furniture and equipment costs per teaching space range from about £16,000 for Design/ Resource to about £32,000 for Electronics. Furniture and equipment accounts for a still higher proportion of the overall costs in Case Study 4, at some 65% of the total, with equipment costs predictably ranking as before. The building costs form a much lower proportion of the total as the work comprises low cost adaptations to the existing building. Across the two case studies, building adaptation costs average only about £150/m2 in comparison with nearly £680/m2 for the cost of the new ground floor extension in Case Study 3.

Overall cost analysis

	Cost £	Cost £/m²
Extensions to existing building (2000m² total area)		
Structural changes to walls, door openings etc	42,853	72
Internal finishings	24,998	42
Mechanical and electrical services	8,000	13
External works	1,781	3
Building Works Total	**77,632**	**130**
Professional fees @ 15%	11,646	
Fixed furniture (from low capacity)	8,210	
Loose furniture (from low capacity)	28,852	
Equipment (from low capacity)	127,725	
ESTIMATED TOTAL PROJECT COST	**£ 483,065**	

Furniture and equipment costs

	Fixed Furniture £	Loose furniture £	Equipment £
Room			
Multimedia area 1	1,841	3,883	20,784
Hot-desking	-	-	13,864
Multimedia area 2	1,197	3,514	23,408
Light Multimedia area	1,875	8,742	21,111
Electronics	874	5,818	18,698
Dry Textiles	1,731	2,869	8,710
Design/Resource	252	5,353	13,208
Prep. room	750	1,725	13,948
Store rooms	1,686		
Totals	8,210	28,852	127,725

Note
Costs at Q2 1995 prices, VAT excluded.

Table 8.2
Case Study 4: Cost breakdown and distribution of costs.

8.18 When furniture and equipment costs are added to the building costs, the overall average costs per m², for both new work and adaptations, are about £615 and £440 respectively for Case Studies 3 and 4. These compare favourably with the capital cost of completely new buildings given earlier of between £900 and £1,100 per m². Also, apart from the small extension in Case Study 3, the re-use of existing accommodation should ensure that additional recurrent provision costs are minimised.

8.19 This exercise shows that modest extensions or adaptations, together with new furniture and equipment, can provide up-to-date design and technology accommodation at up to half the capital cost of an equivalent new building, and with no significant increase in recurrent expenditure. Further significant capital savings could be made if it were feasible to re-use existing items of furniture and equipment.

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Appendix 1 : Space Allocation of Machines & Furniture

The following pages illustrate suggested working distances around each of the pedestal machines shown on the layouts and described in Section 5. Information is also given on spaces around common furniture types. These dimensions alone may not be sufficient to ensure safety but may be used as a guide. Consideration must also be given to the nature of the material to be used, working practices, relationships between machines, etc.

The machines shown in the diagrams do not refer to any particular manufacturer and it is because of this that dimensions given refer only to the space **around** the machine. The information is envisaged to be used for workshops with a mixture of both pedestal and bench mounted machinery. Safe working distances are shown for floor mounted machines only.

The shaded zones on the machine drawings allow for overlap of areas around **adjacent machines** only (see Figure A1/1a). Distances in front of machines are assumed to be against circulation routes. 200mm has been allowed at the back of the machine for cleaning and maintenance purposes unless otherwise stated. It may be assumed that only one machine in the preparation area will be in use at one time and that there is less likelihood of misuse by the operator than in the workshop. For this reason work zones around preparation machines may be shared.

Key to Symbols

Clear Working space

Overlap of space allocated for **machines** only (250mm unless otherwise stated)

Operator position

Wall

Overlap of space allocated for **furniture** only

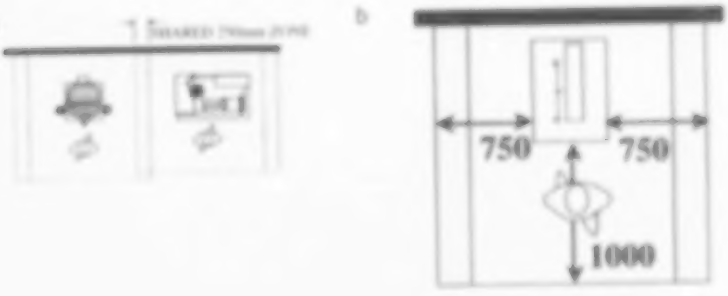


Figure A1/1
a. Shared zoning
b. Area around Drill

Figure A1/2
a. Area around Woodlathe
b. Area around Mortiser

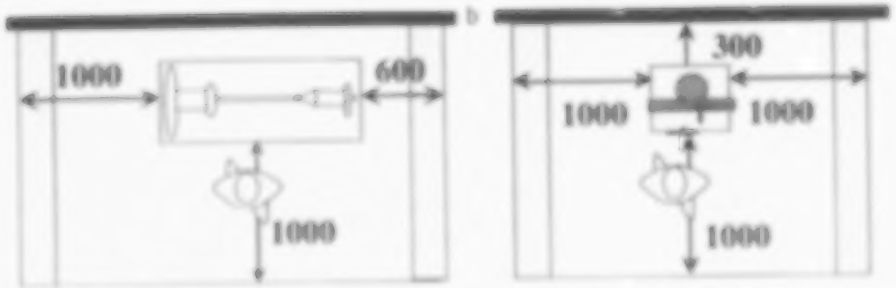
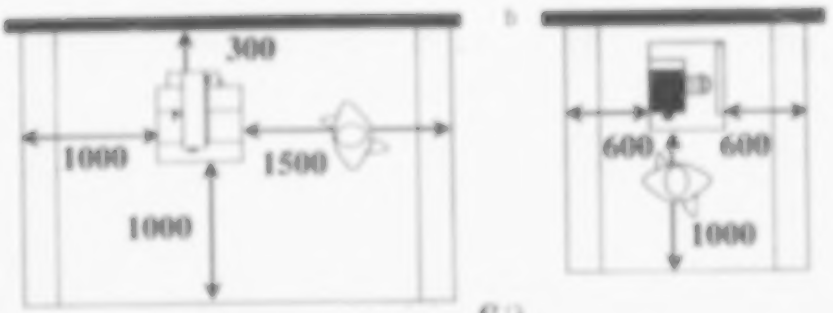
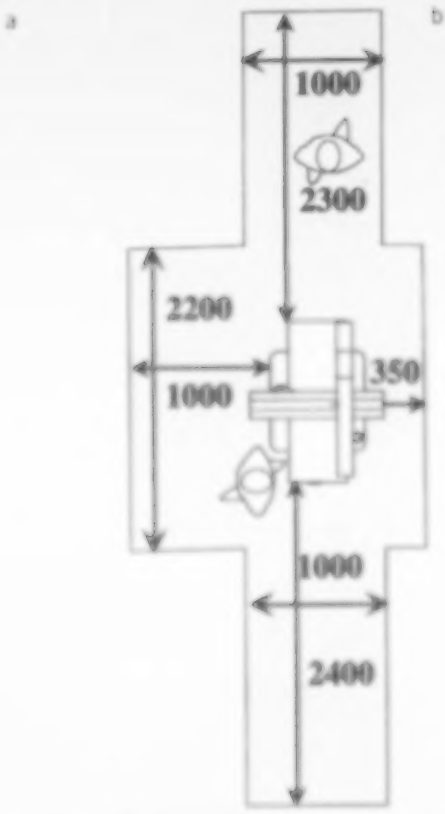


Figure A1/3
a. Area around Bandsaw
b. Area around Linisher





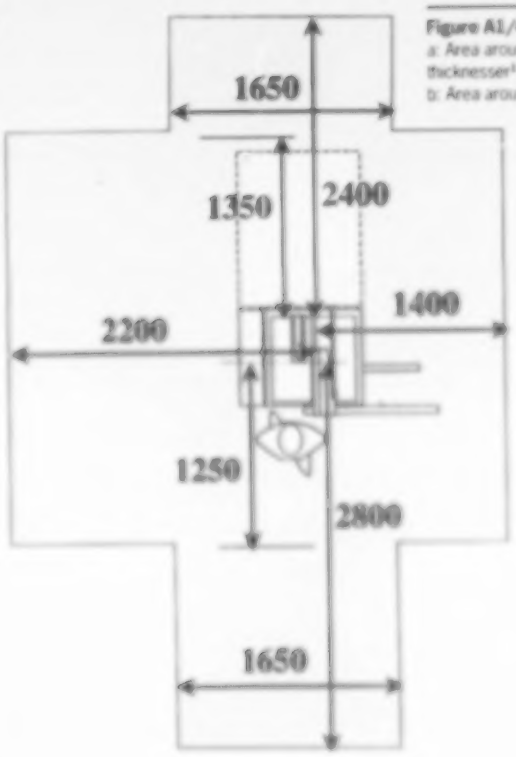
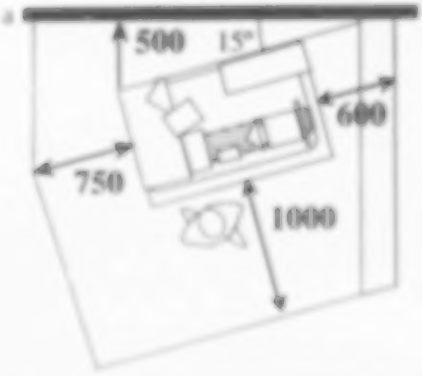
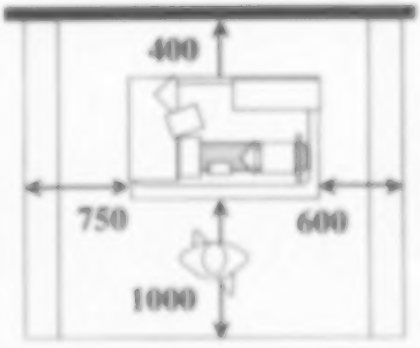


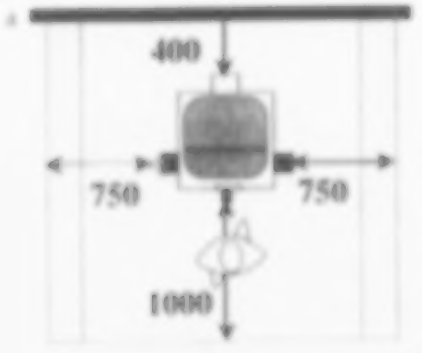
Figure A1/4
a: Area around Planer/ thicknesser[1]
b: Area around Circular saw[1,2,3]





Notes
[1] Space below height of Planer and saw table may be used for mobile storage units.
[2] Large 2.4x1.2m sheets assumed.
[3] 750mm behind headstock only.

Figure A1/5
a: Angled area around Lathe[4]
b: Area around Lathe[4]



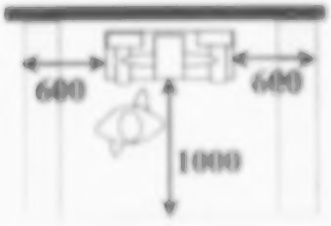


Figure A1/6
a: Area around Milling Machine
b: Area around Buffer

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Appendix 1 : Space Allocation of Machines and Furniture

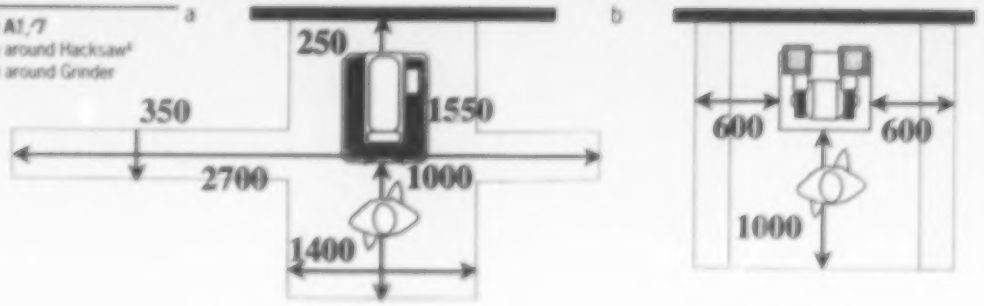


Figure A1/7
a: Area around Hacksaw[2]
b: Area around Grinder

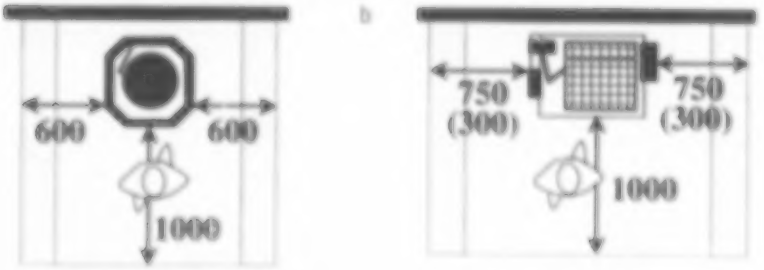


Figure A1/8
a: Area around Horizontal Grindstone
b: Area around Welding bench[2]

Figure A1/9
a: Area around Crucible furnace
b: An area around Moulding bench

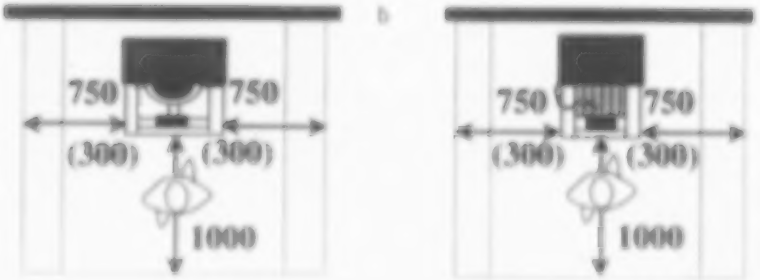


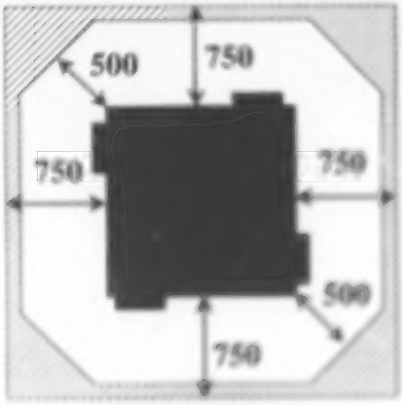
Figure A1/10
a: Area around Chip forge[2]
b: Area around Brazing hearth[2]

Notes
[1] Wall space above 1300mm high (notional height of head in raised position) may be used.
[2] 300mm space allowance if area is to be shared with forge or hearth, or placed in a corner position.

Area around Furniture

Hatched areas on furniture drawings allow for overlap between adjacent items of furniture only. On desks, computer tables and benches (not multi benches) shared hatched areas measure 500mm. This allocation must be increased between tables and benches if there is a large amount of circulation between or a long run of tabling or benching.

a



b

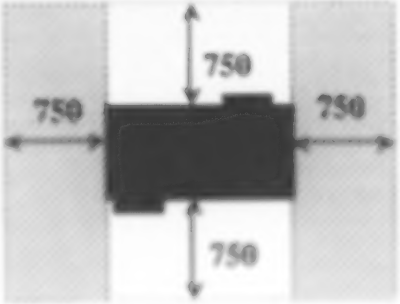
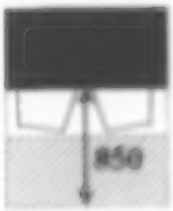


Figure A1/11
a Area around 4 person multibench*.
b Area around 2 person multibench.

Notes
* 500mm overlap on all four sides of 4 person multibench.
* Double drainer sink may be positioned directly next to adjacent worktop.
* In a peninsula arrangement there must always be a permanent work surface on both sides of the cooker.

a



b

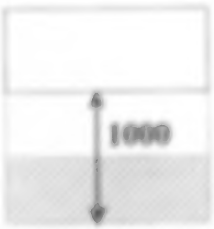
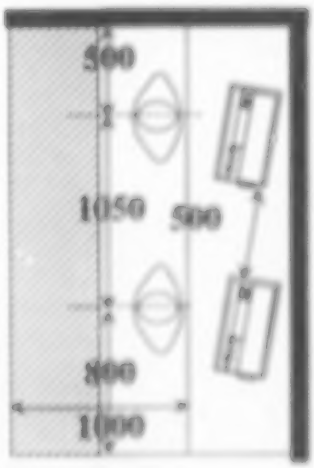


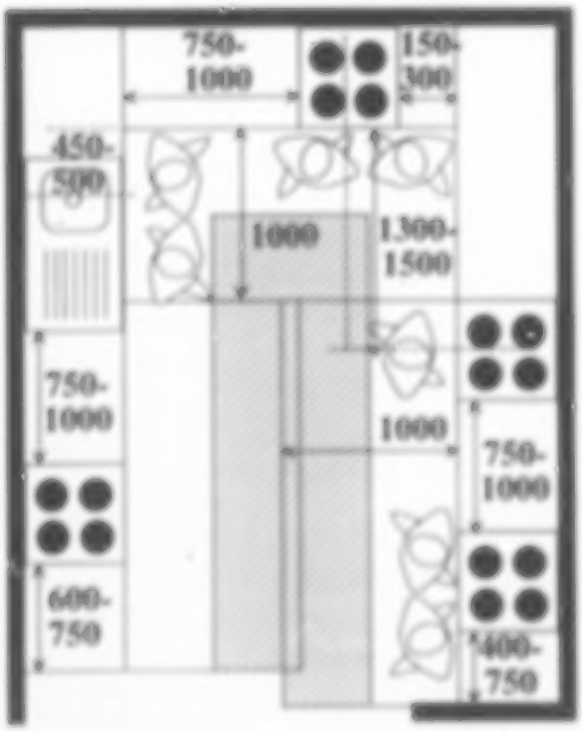
Figure A1/12
a Area around desk and computer table.
b Area around benching and specialist practical tables.

Figure A1/13
a Area around sewing machines.
b Area around food preparation units.*#

a



b



Appendix 2 : Health and Safety in Technology

This section summarises the major health and safety regulations and advisory codes of practice which have direct relevance to school design and technology accommodation. Advice on Health and Safety matters is also given earlier in the publication, and is cross referenced here in brackets. For matters of detail it is advisable to refer to the source reference document.

In most cases, regulations are made under the Health and Safety at Work Etc. Act 1974 (HSWA) and deal with the workplace*. These regulations will refer to 'employers' and 'employees'. In the case of schools, employers will be assumed to be the LEA, governors or trust, and employees the teachers and technicians. Pupils are classed as a third party and may not be covered by the secondary legislation, but are covered under the general requirements of the HSWA.

Control of Substances Hazardous to Health (COSHH)

The COSHH Regulations 1994 are one of the most important items of recent legislation affecting work premises in both the public and private sector, including schools. Employers are responsible for assessing the use of hazardous substances to ensure this is controlled without risk to health. Employees also have a responsibility to report potential problems and may be delegated the task of assessing potential risks in their particular specialist area. Areas of concern in schools are generally:

- School grounds and cleaning stores
- Laboratories
- Workshops
- Art and textiles rooms
- Food rooms
- Print rooms.

Requirements of COSHH fall into four categories:

- Assessment
- Prevention
- Control
- Management.

Forms of control include personal protective equipment and local extract ventilation installations (Section 6). Where possible prevention is preferable to control.

Food Safety Act 1990

This Act contains specific requirements for premises in which food is prepared and cooked. The school kitchen is 'covered' by the Act but not necessarily the food teaching room. The Act has implications for work in mini enterprise projects and where activities are intended to mimic commercial catering. Some of the main points are listed here, but schools should check their legal position and the criteria for eligibility with their local environmental health officer.

- The law will apply in a school food room if food is either sold or given away to any person who is not the maker of the food product.
- If a school sells food it may register itself as a business and be liable to visits by an Environmental Health officer.
- For a school to be a registered business it must sell items for five days consecutively in a five week period.
- The main concerns of the Act are: hand wash basin provision, adequate refrigeration, suitable wash down surfaces, both horizontal and vertical (see Sections 2 and 6).
- When pupils make food for their own consumption in lessons this is considered to mirror domestic kitchen activity. These are therefore not subject to the requirements of the Act.

Electricity at Work Regulations 1989

These regulations place a duty on employers to ensure that as far as possible all electrical equipment and installations are constructed and maintained so as to prevent danger. Following the IEE regulations should ensure compliance with the new regulations. HSE GS23 describes these regulations with direct reference to schools (see Section 6).

Note
* 'Workplace' is defined as premises not classed as domestic.

Woodworking Machines Regulations 1974

These regulations are concerned mainly with the operation of woodworking machines and outline some general requirements for training and woodworking areas in factories. They do, however, represent good practice to be followed in schools. Requirements covered include:

- Workroom layout (see Section 2 and Appendix 1);
- Lighting (see Section 6);
- Heating (see Section 6);
- Flooring (see Section 4);
- Guarding (see Section 5);

The regulations form the basis of advice given for woodworking machinery in other, more recent, documents mentioned in the Appendix and Bibliography. They are largely superseded by the Provision and Use of Work Equipment Regulations.

Supply of Machinery Regulations 1992

Since 1st January 1995 most machinery supplied in the UK has had to meet the health and safety requirements outlined in these regulations, which are aimed at the manufacturers of machinery. The regulations set out clear design criteria for compliance including:

- Lighting (see Section 6);
- Fire risks;
- Control devices (see Section 6);
- Noise emission;
- Guarding.

When the manufacturer is satisfied all criteria have been met then a CE marking should be affixed to the machine. False certification by a manufacturer is a criminal offence.

Schools should ensure a CE marking is placed on a machine before purchasing. The regulations do not apply to second-hand or donated machinery. Meeting the requirements of these regulations will ensure compliance with Section 6 of the HSWA which deals with the general safety of machinery in the workplace.

Workplace (Health, Safety and Welfare) Regulations 1992

These regulations apply to every new workplace built after 1 January 1993. Existing premises must conform after January 1996. The directive covers aspects of Health and Safety in the Workplace (replacing a number of old regulations), and sets out the responsibilities of both employer and employee. Issues of direct relevance to design and technology include:

- Maintenance;
- Environmental issues (see Section 6);
- Room dimensions (the recommended 4.6m2 per employee i.e. the teacher, excludes only areas where staff work and not general staff rooms, recreational areas or classrooms);
- Workstation layout and furniture (see Sections 2 and 4);
- Floor and circulation routes (see Section 2 and Appendix 1);

Manual Handling Operations Regulations 1992

These regulations seek to prevent injury to any part of the body during the process of manual handling at work. They stress employers' responsibility to ensure employees' health and safety through the avoidance of any manual handling operation involving risk of injury. In the case of schools this would apply to staff working in preparation areas (see Section 3).

The regulations give design guidance aimed at reducing the risk of injury during manual handling operations. The considerations outlined are:

- Space allocation (see Sections 2, 3 and Appendix 1);
- Flooring (see Section 4);
- Temperature (see Section 6);

- Ventilation (see Section 6).
- Lighting (see Section 6).
- Storage details (see Section 4).

An ergonomic approach to lifting and the use of mechanical or automated aids, e.g. wheeled trolleys, are encouraged.

Management of Health and Safety at Work Regulations 1993

These regulations set out general duties for employers concerning the management of health and safety for their employees. They cover four basic aspects of health and safety:

- Planning
- Organisation
- Control monitoring
- Review

The regulations have little direct relevance to the design of school buildings. However, certain management procedures may result in specific requirements for the design and layout of design and technology areas.

Personal Protective Equipment (PPE) at Work Regulations 1993

The regulations aim to ensure that employers provide adequate PPE for their employees. PPE is defined as any item which protects a person against any health and safety risk. It does not, however, cover any equipment which may be required as a direct result of COSHH regulations.

Like COSHH, the PPE regulations regard prevention as an initial action. For example, suitable guarding to a machine is preferable to the operator wearing goggles when using the unguarded machine.

Direct reference is made to the accommodation of PPE, *e.g.* coat pegs for protective clothing (see Section 4).

Health and Safety (Display Screen Equipment) Regulations 1992

These regulations set out the Health and Safety management duties of employers to employees who habitually work with display screen equipment.

Although teachers would rarely be considered habitual users of IT due to their role as instructors, the document is a valuable source of reference when designing an environment where display screen equipment is used. Issues covered include:

- Furniture (see Section 4)
- Lighting (see Section 6)
- Space
- Noise (see Section 6)
- Heat and humidity (see Section 6)

Provision and Use of Work Equipment Regulations 1993

The regulation's prime objective is to ensure that all work equipment provided for use at work meets various health and safety standards. 'Equipment' may include component parts of an item of machinery (see Supply of Machinery Regulations 1992).

The regulations set out a number of requirements that both equipment manufacturers and employers must meet:

- Safe construction and design of equipment, its component parts and additional safety features (see Section 5).
- Suitability for purpose (see Section 5).
- Conditions in which equipment is used, which will include suitable space allocation for that equipment (see Appendix 1).

The following are relevant advisory codes of practice.

BS 4163 Code of Practice for Health and Safety in workshops of schools and similar establishments 1984

BS 4163 gives guidance to the planners and users of school workshops. Various recommendations are made about the safe use and supply of equipment and machinery used in workshops. The standard is divided into several sections as follows:

General Brief

Includes information on briefing by teachers to architects, general planning, building and furniture considerations (see Sections 2, 4 and 5).

Storage

Makes reference to the storage requirements of hazardous materials, bulk materials and specific types of materials e.g. plastics (see Sections 3 and 4).

Environmental

Covers such aspects as lighting, heating, ventilation, flooring and wall surfaces (see Section 4).

Services

Detailed information is given about main workshop switchgear including electrical circuits, sockets outlets and emergency switching devices (see Sections 5 and 6).

Machinery

Detailed recommendations are given for individual machines likely to be placed in a school workshop highlighting requirements for ventilation, siting, controls, guarding and personal safety (see Sections 2, 5 and 6).

BS 5304: Code of Practice for Safeguarding of Machinery

This code of practice, like the Provision and Use of Work Equipment Regulations 1992 looks at various considerations associated with the use of machinery. The standard is aimed at anyone who designs, manufactures, supplies, installs, uses, maintains or modifies machines. Information on installation will, of course, be of interest to architects and others involved in a design and technology building project. Although of more direct relevance to industry, the standard does contain some useful references to:

- Machine safety features
- General outlined principles of safety
- Servicing details
- Layout of machinery
- Safe working practices

Appendix 3: Check List

Planning

A building project for design and technology, or for any subject, should be considered in the context of the school's long-term development plan. The following summarises key planning points.

Number and Balance of Timetabled Teaching Spaces

When calculating the number and type of specialist spaces consider:

- The percentage of curriculum time spent on D&T at each key stage.
- The maximum group size.
- Whether any vocational courses will be taught at KS4 or in the sixth form.
- The particular curricular emphasis of the department.
- The size of the department, for example if small, one or more spaces may have to provide for more than one specialism.

Size of a Teaching Space

The following may have implications for the size of a space:

- The range of activities likely to take place.
- The scale and quantity of equipment to be used.
- Maximum group sizes.
- The level of storage to be provided in the teaching space.
- Whether sixth form pupils will share the space.

Support Spaces

Teaching and non-teaching support spaces may include:

- Areas for the preparation and storage of materials and for keeping pupils work in progress.
- A staff base.
- A design / resource area.
- A project room, particularly for sixth formers.
- An external project area.

Planning Principles

Design and technology is taught through a number of different specialist areas. It is useful to consider the following when planning new or adapting existing accommodation:

- If specialist spaces are grouped together equipment and resources are more easily shared.
- There are practical advantages in locating support spaces, both teaching and non-teaching, in a way that enables them to serve a number of spaces.
- The position of other departments, where there may be cross-curricular links.

Timetabled Teaching Spaces

It is important to have a strategy when organising the furniture and equipment layout of a specialist space, in order to ensure the safety and comfort of the users. Some key points to consider are:

- Design and technology involves a broad range of designing and making activities which may be happening concurrently.
- Allowances should be made for pupils to move safely around the space.
- Distances around machines and benches should enable pupils to work safely.
- Restricting fixed furniture and equipment to the perimeter of the space leaves the centre free for possible rearrangement.
- If coats and bags are brought into the teaching space they should be appropriately stored safely away from circulation routes.
- The type and quantity of equipment and furniture should be appropriate for the size of the space.
- Where sixth form or vocational courses are offered, this may affect the nature of the provision.

Storage

Storage for D&T is best provided in the form of walk in stores which are accessible from the main classroom space and deep enough to accommodate trolleys in bi-mesh shelving. When calculating storage need it is useful to consider the following:

- Materials and items under construction will be in a variety of shapes and sizes and storage methods will need to reflect this.
- Certain materials such as inflammable liquids must be stored in accordance with the relevant regulations.
- Foods found must be kept in a ventilated area at an appropriate temperature.
- Some pieces of equipment and/or pupils records may need secure storage.
- Construction materials should be stored separately from the teaching area.

Furniture

The range of furniture should be sufficiently flexible to allow for variety in room layout and the possibility of furniture being moved between spaces. The following points are worth consideration:

- The specialist tables that are provided for D&T work should be usable for general design work wherever possible.
- Permanent benching is most useful at a minimum width of 600mm and a standing height of 850mm.
- Fixed cupboards below multi benches can reduce flexibility and make the bench less comfortable to sit at.
- Mobile storage units have the advantage of allowing resources to be moved between spaces. The trays contained by such units can be part of a standardised system, which includes trolleys.
- Long lengths of metal, timber or plastic must be safely stored in appropriate racks.
- Chairs should be easy to move around the room. Adjustable chairs are desirable for use with computers.

Equipment

All machines and serviced items of equipment must be installed according to the relevant health and safety regulations. The following points are worth considering:

- When positioning a machine in the workshop it is important to take into account the way it will be used.
- There must be sufficient space for a pupil to move away from a machine in the event of an accident.
- All machines should have appropriate guarding and other safety features.
- Bench mounted machines should be at a height which allows younger pupils to use them.
- Certain machines can only be used by a qualified person.
- It is preferable to house the prepara tion machines (circular saw, planer and linisher) in a separate area.
- It is desirable to locate hot metal equipment in a separate supervised area.
- It is generally advisable to position CNC machines in clean areas.

Services

All service installations must comply with current regulations. Below are some of the key points to note:

Electricity

- Each work area should have an emergency stop system controlling everything except hazard removing equipment and possibly computers.
- All fixed equipment must have an isolating switch and emergency stop features.
- Residual current devices provide additional protection to socket outlet circuits.
- There are specific requirements relating to electrical systems in furniture.

Ventilation and Extraction

- Certain workshop processes that produce fumes should be carried out in a well ventilated space, and may require mechanical extract.
- Fume extraction must be provided to heat treatment machines.
- Dust extraction is necessary from woodworking machines, fine wood dust must be separate from wood flakes.

Lighting and Acoustics

- Local task lighting is usually provided on pedestal machinery.
- Emergency lighting is necessary wherever potentially dangerous machines are used.
- Consideration should be given to the noise produced by machines when planning a suite of spaces.
- Finishes can be used to affect the acoustic quality of the room.

Cost Guidance

The following points are worth considering:

- Professional fees can add a further 10%-15% to the cost of a new design and technology building.
- The cost of procuring furniture and equipment needs to be taken into account when setting the budget.
- Advice from the Local Licences and Fayre Office on VAT should be obtained in relation to non-taxing parts of the work.
- Phasing a project can increase the overall cost.

- The total of a new design and technology building can be between £900 and £1,100* per m². Adaptation and refurbishment of existing spaces to provide equivalent accommodation can cost less than half of this.
- Temporary buildings can provide a cost effective solution to short term accommodation difficulties.
- Savings can be made by re-using existing furniture and equipment.

Note
* Cost at Q2 1995 valued average prices.

Glossary

BESA: British Educational Supplies Association.

BS: British Standard.

CAD: Computer Aided Design.

CAM: Computer Aided Manufacture.

CNC: Computer Numerically Controlled.

COSHH: Control of Substances Hazardous to Health.

CD ROM: Compact Disc Read Only Memory, computerised reference material.

D&T: Design and technology.

DEDICATED USE USE (%): The average amount of time that a space is used, expressed as a percentage of the total number of teaching periods available per week.

E&E: Furniture and equipment.

GNVQ: General National Vocational Qualification, a range of vocational courses usually taken in the sixth form for two semesters at KS4.

IT: Information Technology. The subject taught in schools and the equipment associated with it.

KEY STAGE (KS): The statutory school years are divided into four phases which mark stages of development. These approximate to age as follows:

- KS1 age 5 - 7
- KS2 age 7 - 11
- KS3 age 11 - 14
- KS4 age 14 - 16

LEA: Local Education Authority.

MIDDLE SCHOOL: Middle schools may be either 'middle deemed primary' with an age range of 9-12 or 'middle deemed secondary' with an age range of 9-13.

MULTI-PURPOSE: A sturdy bench for hand tool work with wood, metal and plastics. Incorporates vices.

MULTI-PURPOSE WORKROOM: Workshops which enable work with wood, metal and plastic material.

OHP: Overhead Projector.

PERMANENT MACHINERY: Machinery which is free standing and mounted on a heavy, sturdy base.

PCB: Printed circuit boards. Plastic covered copper board which may be printed with circuit designs and subsequently assembled as such.

PUPIL PLACE: A place to work, i.e. table space and seat, for one pupil.

SUITE: In this publication a suite of spaces refers to an identifiable group of spaces.

TEACHING PERIODS: Schools divide up the week in different ways. The most common are 40 periods of 35 minutes and 30 periods of 50 minutes.

TSI: Technology Schools Initiative, capital funding given to schools with a special interest in design and technology.

TECHNOLOGY USE: Secondary school with a particular emphasis on maths, science and / or technology.

VDU: Visual Display Unit, the computer screen.

YEARS: 7 TO 11: Secondary school years are numbered from 7 (first year) to 11 (end of statutory schooling). The sixth form is sometimes referred to as years 12 and 13.

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